

**SUBSTITUTED ARYLAMINE DERIVATIVES AND METHODS OF USE**

Sub  
A'  
5 This application claims the benefit of U.S.  
Provisional Application Nos. 60/261,360, filed January 12,  
2001, and 60/323,686 filed September 19, 2001, which are  
hereby incorporated by reference

**FIELD OF THE INVENTION**

10 This invention is in the field of pharmaceutical  
agents and specifically relates to compounds, compositions,  
uses and methods for treating cancer and angiogenesis-  
related disorders.

**BACKGROUND OF THE INVENTION**

15 Protein kinases represent a large family of proteins  
which play a central role in the regulation of a wide  
variety of cellular processes, maintaining control over  
20 cellular function. A partial list of such kinases includes  
ab1, Akt, bcr-ab1, Blk, Brk, Btk, c-kit, c-met, c-src,  
CDK1, CDK2, CDK3, CDK4, CDK5, CDK6, CDK7, CDK8, CDK9,  
CDK10, cRaf1, CSF1R, CSK, EGFR, ErbB2, ErbB3, ErbB4, Erk,  
Fak, fes, FGFR1, FGFR2, FGFR3, FGFR4, FGFR5, Fgr, flt-1,  
25 Fps, Frk, Fyn, Hck, IGF-1R, INS-R, Jak, KDR, Lck, Lyn, MEK,  
p38, PDGFR, PIK, PKC, PYK2, ros, tie, tie2, TRK, Yes, and  
Zap70. Inhibition of such kinases has become an important  
therapeutic target.

30 Certain diseases are known to be associated with  
deregulated angiogenesis, for example ocular  
neovascularisation, such as retinopathies (including  
diabetic retinopathy), age-related macular degeneration,  
psoriasis, hemangioblastoma, hemangioma, arteriosclerosis,  
inflammatory disease, such as a rheumatoid or rheumatic  
35 inflammatory disease, especially arthritis (including  
rheumatoid arthritis), or other chronic inflammatory

disorders, such as chronic asthma, arterial or post-transplantational atherosclerosis, endometriosis, and neoplastic diseases, for example so-called solid tumors and liquid tumors (such as leukemias).

5           At the center of the network regulating the growth and differentiation of the vascular system and its components, both during embryonic development and normal growth, and in a wide number of pathological anomalies and diseases, lies the angiogenic factor known as Vascular Endothelial Growth  
10 Factor" (VEGF; originally termed 'Vascular Permeability Factor", VPF), along with its cellular receptors (see G. Breier et al., Trends in Cell Biology, 6, 454-6 (1996)).

VEGF is a dimeric, disulfide-linked 46-kDa glycoprotein related to "Platelet-Derived Growth Factor"  
15 (PDGF); it is produced by normal cell lines and tumor cell lines; is an endothelial cell-specific mitogen; shows angiogenic activity in in vivo test systems (e.g. rabbit cornea); is chemotactic for endothelial cells and monocytes; and induces plasminogen activators in endothelial cells,  
20 which are involved in the proteolytic degradation of extracellular matrix during the formation of capillaries. A number of isoforms of VEGF are known, which show comparable biological activity, but differ in the type of cells that secrete them and in their heparin-binding capacity. In  
25 addition, there are other members of the VEGF family, such as "Placenta Growth Factor" (PlGF) and VEGF-C.

VEGF receptors (VEGFR) are transmembranous receptor tyrosine kinases. They are characterized by an extracellular domain with seven immunoglobulin-like domains and an  
30 intracellular tyrosine kinase domain. Various types of VEGF receptor are known, e.g. VEGFR-1 (also known as flt-1), VEGFR-2 (also known as KDR), and VEGFR-3.

A large number of human tumors, especially gliomas and carcinomas, express high levels of VEGF and its receptors.

2025 RELEASE UNDER E.O. 14176

This has led to the hypothesis that the VEGF released by tumor cells stimulates the growth of blood capillaries and the proliferation of tumor endothelium in a paracrine manner and through the improved blood supply, accelerate tumor growth. Increased VEGF expression could explain the occurrence of cerebral edema in patients with glioma. Direct evidence of the role of VEGF as a tumor angiogenesis factor *in vivo* is shown in studies in which VEGF expression or VEGF activity was inhibited. This was achieved with anti-VEGF antibodies, with dominant-negative VEGFR-2 mutants which inhibited signal transduction, and with antisense-VEGF RNA techniques. All approaches led to a reduction in the growth of glioma cell lines or other tumor cell lines *in vivo* as a result of inhibited tumor angiogenesis.

Angiogenesis is regarded as an absolute prerequisite for tumors which grow beyond a diameter of about 1-2 mm; up to this limit, oxygen and nutrients may be supplied to the tumor cells by diffusion. Every tumor, regardless of its origin and its cause, is thus dependent on angiogenesis for its growth after it has reached a certain size.

Three principal mechanisms play an important part in the activity of angiogenesis inhibitors against tumors: 1) Inhibition of the growth of vessels, especially capillaries, into avascular resting tumors, with the result that there is no net tumor growth owing to the balance that is achieved between cell death and proliferation; 2) Prevention of the migration of tumor cells owing to the absence of blood flow to and from tumors; and 3) Inhibition of endothelial cell proliferation, thus avoiding the paracrine growth-stimulating effect exerted on the surrounding tissue by the endothelial cells which normally line the vessels. See R. Connell and J. Beebe, *Exp. Opin. Ther. Patents*, 11, 77-114 (2001).

VEGF's are unique in that they are the only angiogenic growth factors known to contribute to vascular hyperpermeability and the formation of edema. Indeed, vascular hyperpermeability and edema that is associated with the expression or administration of many other growth factors appears to be mediated via VEGF production.

Inflammatory cytokines stimulate VEGF production. Hypoxia results in a marked upregulation of VEGF in numerous tissues, hence situations involving infarct, occlusion, ischemia, anemia, or circulatory impairment typically invoke VEGF/VPF-mediated responses. Vascular hyperpermeability, associated edema, altered transendothelial exchange and macromolecular extravasation, which is often accompanied by diapedesis, can result in excessive matrix deposition, aberrant stromal proliferation, fibrosis, etc. Hence, VEGF-mediated hyperpermeability can significantly contribute to disorders with these etiologic features. As such, regulators of angiogenesis have become an important therapeutic target.

Schipper US patent 3,226,394, issued Dec. 28, 1965, describes anthranilamides as CNS depressants. Japanese patent JP2000256358 describes pyrazole derivatives that block the calcium release-activated calcium channel. EP application 9475000, published 6 October 1999, describes compounds as PGE<sub>2</sub> antagonists. PCT publication WO96/41795, published 27 December 1996, describes benzamides as vasopressin antagonists. WO01/29009 describes aminopyridines as KDR inhibitors. WO01/30745 describes anthranilic acids as CGMP phosphodiesterase inhibitors. WO00/02851, published 20 Jan 2000 describes arylsulfonylaminoaryl amides as guanylate cyclase activators. WO98/45268 describes nicotinamide derivatives as PDE4 inhibitors. WO98/24771 describes benzamides as vasopressin antagonists.



US Patent No. 5,532,358, issued July 2, 1996, describes the preparation of 2-(cyclopropylamino)-N-(2-methoxy-4-methyl-3-pyridinyl)-3-pyridinecarboxamide as an intermediate for HIV inhibitors. Triazine-substituted amines are described for their aggregating ability (J. Amer. Chem. Soc., 115, 905-16 (1993). Substituted imidazolines were tested for their antidepressant activity in Ind. J. Het. Chem., 2, 129-32 (1992). N-(4-Pyridyl)anthranilic amides were described in Chem Abstr. 97:109837 (1981). PCT publication WO99/32477, published 1 July 1999, describes anthranilamides as anti-coagulants. US patent 6,140,351 describes anthranilamides as anti-coagulants. PCT publication WO99/62885, published 9 December 1999, describes 1-(4-aminophenyl)pyrazoles as antiinflammatories. PCT publication WO00/39111, published 6 July 2000, describes amides as factor Xa inhibitors. PCT publication WO00/39117, published 6 July 2000, describes heteroaromatic amides as factor Xa inhibitors. PCT publication WO00/27819, published 18 May 2000, describes anthranilic acid amides as VEGF inhibitors. PCT publication WO00/27820 published 18 May 2000, describes N-aryl anthranilic acid amides as VEGF inhibitors. 7-Chloroquinolinylamines are described in FR2168227 as antiinflammatories. WO01/55114, published 2 Aug. 2001, describes nicotinamides for the treatment of cancer. WO01/55115, published 2 Aug. 2001; describes nicotinamides for the treatment of apoptosis. WO01/85715, published 15 November 2001, describes substituted pyridines and pyrimidines as anti-angiogenesis agents. PCT publication WO01/85691 published 15 November 2001, describes anthranilic amides as VEGF inhibitors. PCT publication WO01/85671 published 15 November 2001, describes anthranil amides as VEGF inhibitors. PCT publication WO01/81311 published 1 November 2001, describes anthranilic amides as VEGF inhibitors. However, compounds of the current invention

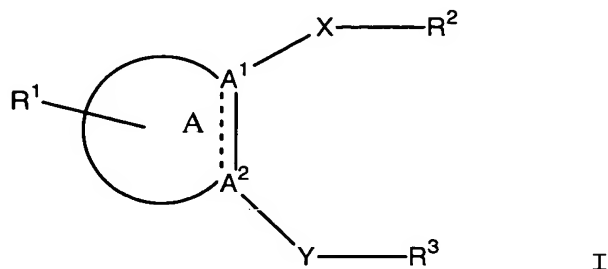
2025 RELEASE UNDER E.O. 14176

have not been described as inhibitors of angiogenesis such as for the treatment of cancer.

# DESCRIPTION OF THE INVENTION

5

A class of compounds useful in treating cancer and angiogenesis is defined by Formula I



10

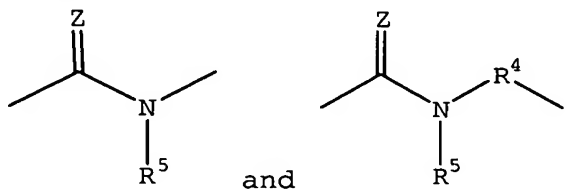
wherein each of A<sup>1</sup> and A<sup>2</sup> is independently C or N;  
wherein A<sup>1</sup>-A<sup>2</sup> together are part of a ring A selected from 5-  
or 6-membered heteroaryl,

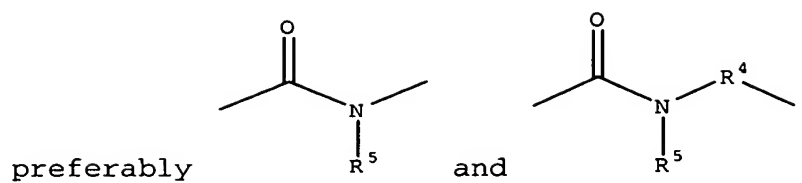
more preferably 5-membered heteroaryl selected from  
thienyl, oxazolyl, imidazolyl, pyrrolyl,  
pyrazolyl, isoxazolyl, triazolyl, isothiazolyl,  
and

6-membered heteroaryl selected from pyridyl,  
pyrazinyl, pyrimidinyl and pyridazinyl,  
even more preferably pyridyl or pyrimidinyl,  
most preferably pyridyl;

20

wherein X is selected from

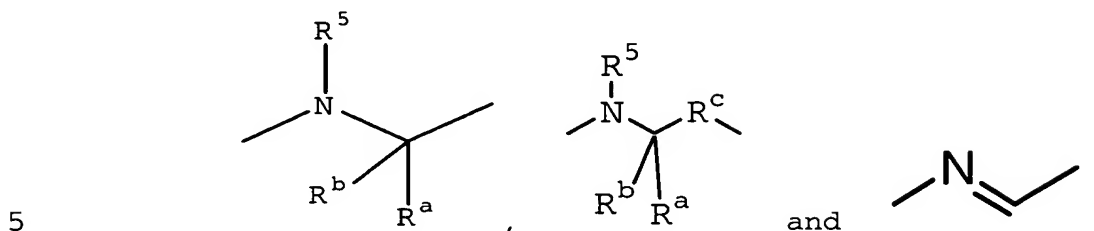




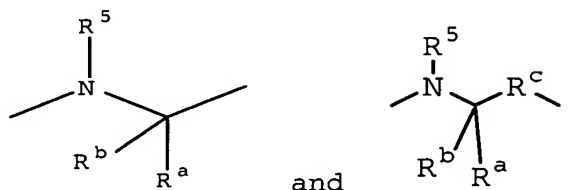
more preferably -C(O)-NH-;

wherein Z is oxygen or sulfur;

wherein Y is selected from



preferably selected from



more preferably -NH-CH<sub>2</sub>-;

10 wherein R<sup>a</sup> and R<sup>b</sup> are independently selected from H, halo, and C<sub>1-4</sub>-alkyl substituted with R<sup>1</sup>, or wherein R<sup>a</sup> and R<sup>b</sup> together form C<sub>3</sub>-C<sub>4</sub> cycloalkyl,

preferably H, halo, and C<sub>1-2</sub>-alkyl substituted with R<sup>1</sup>, or wherein R<sup>a</sup> and R<sup>b</sup> together form C<sub>3</sub>-C<sub>4</sub> cycloalkyl, more preferably H, halo and C<sub>1</sub>-C<sub>2</sub>-alkyl,

15 even more preferably H;

wherein R<sup>c</sup> is C<sub>1</sub>-C<sub>4</sub> alkylenyl, where one of the CH<sub>2</sub> groups may be substituted with an oxygen atom or an -NH-, preferably C<sub>1</sub>-C<sub>2</sub> alkylenyl, where one of the CH<sub>2</sub> groups

20 may be substituted with an oxygen atom or an -NH-, more preferably -CH<sub>2</sub>-;

wherein R<sup>1</sup> is one or more substituents independently selected from H, halo, -OR<sup>7</sup>, oxo, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -COR<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, cycloalkyl, optionally substituted phenylalkylenyl,

- optionally substituted 5-6 membered heterocyclyl,  
optionally substituted heteroarylalkylenyl, optionally  
substituted phenyl, lower alkyl, cyano, lower  
hydroxyalkyl, lower carboxyalkyl, nitro, lower alkenyl,  
5 lower alkynyl, lower aminoalkyl, lower alkylaminoalkyl  
and lower haloalkyl;  
preferably H, halo, -OR<sup>7</sup>, oxo, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>,  
-COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>,  
cycloalkyl, optionally substituted 5-6 membered  
10 heterocyclyl, optionally substituted phenyl, C<sub>1</sub>-C<sub>2</sub>-  
alkyl, cyano, C<sub>1</sub>-C<sub>2</sub>-hydroxyalkyl, C<sub>1</sub>-C<sub>3</sub>-carboxyalkyl,  
nitro, C<sub>2</sub>-C<sub>3</sub>-alkenyl, C<sub>2</sub>-C<sub>3</sub>-alkynyl and C<sub>1</sub>-C<sub>2</sub>-haloalkyl,  
more preferably H, halo, -OR<sup>7</sup>, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>,  
-COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>,  
15 cycloalkyl, optionally substituted 5-6 membered  
heterocyclyl, optionally substituted phenyl, C<sub>1-2</sub>-  
alkyl, cyano, C<sub>1-2</sub>-hydroxyalkyl, C<sub>1-3</sub>-carboxyalkyl,  
nitro, C<sub>2-3</sub>-alkenyl, C<sub>2-3</sub>-alkynyl and C<sub>1-2</sub>-haloalkyl,  
additionally preferred are H, chloro, fluoro,  
20 bromo, amino, hydroxy, methyl, ethyl, propyl,  
trifluoromethyl, methoxy, ethoxy,  
trifluoromethoxy, carboxymethyl, unsubstituted or  
substituted phenyl and unsubstituted or  
substituted heteroaryl selected from thienyl,  
25 furanyl, pyridyl, imidazolyl, and pyrazolyl;  
wherein R<sup>2</sup> is selected from  
a) substituted or unsubstituted 6-10 membered aryl,  
b) substituted or unsubstituted 5-6 membered  
heterocyclyl,  
30 c) substituted or unsubstituted 9-11 membered fused  
heterocyclyl,  
d) cycloalkyl, and  
e) cycloalkenyl,

preferably substituted or unsubstituted aryl selected  
from phenyl, naphthyl, indenyl and  
tetrahydronaphthyl, substituted or unsubstituted 5-  
6 membered heteroaryl, and substituted or  
5 unsubstituted 9-10 membered fused heteroaryl,  
more preferably phenyl, indazolyl, indolyl, 2,1,3-  
benzothiadiazolyl, isoquinolyl, quinolyl, and  
quinazolinyl,  
even more preferably phenyl, indazolyl, indolyl,  
10 isoquinolyl and quinolyl;  
wherein substituted R<sup>2</sup> is substituted with one or more  
substituents independently selected from halo, -OR<sup>7</sup>,  
-SR<sup>7</sup>, -SO<sub>2</sub>R<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>,  
-NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, -NH(C<sub>1</sub>-C<sub>4</sub> alkylenylR<sup>7</sup>),  
15 optionally substituted cycloalkyl, optionally  
substituted 5-6 membered heterocyclyl, optionally  
substituted phenyl, lower alkyl substituted with R<sup>1</sup>,  
cyano, nitro, lower alkenyl and lower alkynyl,  
preferably halo, -OR<sup>7</sup>, -SR<sup>7</sup>, -SO<sub>2</sub>R<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>,  
20 -COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -NH(C<sub>1</sub>-C<sub>2</sub>-alkylenylR<sup>7</sup>), -(C<sub>1</sub>-C<sub>2</sub>-  
alkylenyl)NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>,  
optionally substituted cycloalkyl, optionally  
substituted 5-6 membered heterocyclyl, optionally  
substituted phenyl, optionally substituted phenyl-C<sub>1</sub>-  
25 C<sub>2</sub>-alkylenyl, optionally substituted 5-6 membered  
heterocyclyl-C<sub>1</sub>-C<sub>2</sub>-alkylenyl, C<sub>1</sub>-C<sub>2</sub>-alkyl, cyano, C<sub>1</sub>-C<sub>2</sub>-  
hydroxyalkyl, nitro and C<sub>1</sub>-C<sub>2</sub>-haloalkyl,  
more preferably halo, -OR<sup>7</sup>, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>,  
-COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -NH(C<sub>1</sub>-C<sub>2</sub>-alkylenyl-R<sup>7</sup>), -(C<sub>1</sub>-C<sub>2</sub>-  
30 alkylenyl)NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>,  
optionally substituted cycloalkyl, optionally  
substituted 5-6 membered heterocyclyl, optionally  
substituted phenyl, optionally substituted phenyl-  
C<sub>1</sub>-C<sub>2</sub>-alkylenyl, optionally substituted 5-6 membered

2007033400

- heterocyclyl-C<sub>1</sub>-C<sub>2</sub>-alkylenyl, C<sub>1</sub>-C<sub>2</sub>-alkyl, cyano, C<sub>1</sub>-C<sub>2</sub>-hydroxyalkyl, nitro and C<sub>1</sub>-C<sub>2</sub>-haloalkyl, additionally preferred are chloro, fluoro, amino, hydroxy, cyclohexyl, phenylmethyl, morpholinylmethyl, methylpiperidinylmethyl, methylpiperazinylmethyl, ethyl, propyl, trifluoromethyl, phenyloxy, methoxy and ethoxy; wherein R<sup>3</sup> is selected from aryl, preferably phenyl;
- 10 wherein R<sup>3</sup> is substituted with one or more substituents independently selected from halo, -OR<sup>7</sup>, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, cycloalkyl, optionally substituted 5-6 membered heterocyclyl, optionally substituted heteroarylalkylenyl, optionally substituted phenyl, lower alkyl substituted with R<sup>1</sup>, cyano, nitro, lower alkenyl and lower alkynyl, preferably halo, -OR<sup>7</sup>, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, cyano, lower hydroxyalkyl, lower aminoalkyl and nitro, more preferably halo, -OR<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, cyano, amino-C<sub>1</sub>-C<sub>2</sub>-alkyl, hydroxy-C<sub>1</sub>-C<sub>2</sub>-alkyl, and nitro, even more preferably chloro, fluoro, amino, hydroxy, hydroxymethyl, aminomethyl, nitro, methoxy and ethoxy;
- 25 wherein R<sup>4</sup> is independently selected from C<sub>2</sub>-C<sub>4</sub> alkylenyl, C<sub>2</sub>-C<sub>4</sub> alkenylenyl and C<sub>2</sub>-C<sub>4</sub> alkynylenyl, where one of the CH<sub>2</sub> groups may be substituted with an oxygen atom or an -NH-, preferably C<sub>2-3</sub>-alkylenyl, where one of the CH<sub>2</sub> groups may be substituted with an oxygen atom or an -NH-;
- 30 wherein R<sup>5</sup> is selected from H, lower alkyl, phenyl and lower aralkyl, preferably H or C<sub>1-2</sub>-alkyl;

wherein  $R^6$  is selected from H or  $C_{1-6}$ -alkyl; and  
wherein  $R^7$  is selected from H, lower alkyl, phenyl, 5-6  
membered heterocyclyl,  $C_3$ - $C_6$  cycloalkyl, and lower  
haloalkyl,

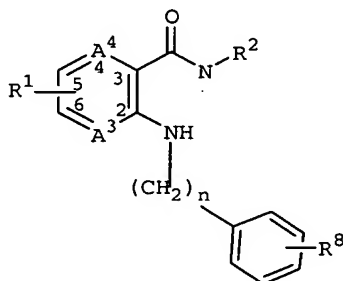
5 preferably H,  $C_{1-2}$ -alkyl, phenyl,  $C_3$ - $C_6$  cycloalkyl and  $C_{1-2}$ -  
haloalkyl,

more preferably H, methyl, ethyl, cyclopropyl,  
cyclohexyl and trifluoromethyl;

and pharmaceutically acceptable salts thereof;

10 provided  $R^3$  is substituted with one or more radicals  
selected from  $-OR^7$ ,  $-SR^7$ ,  $-CO_2R^7$ ,  $-CONR^7R^7$ ,  $-COR^7$ ,  $-NR^7R^7$ ,  
lower aminoalkyl, lower alkylaminoalkyl,  $-SO_2NR^7R^7$ ,  
 $-NR^7C(O)OR^7$ ,  $-NR^7C(O)R^7$ , cyano or lower hydroxyalkyl.

The invention also relates to compounds of Formula II



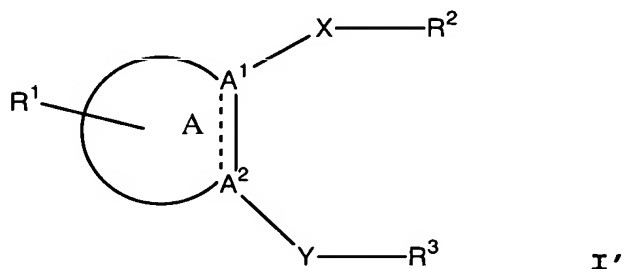
II

15

wherein each of  $A^3$  and  $A^4$  is independently C or N, provided  
at least one of  $A^3$  and  $A^4$  is N; wherein  $n$  is 1-2; wherein  $R^1$   
is one or more substituents independently selected from H,  
20 chloro, fluoro, bromo, amino, hydroxy, methyl, ethyl,  
propyl, trifluoromethyl, methoxy, ethoxy, trifluoromethoxy,  
carboxymethyl, unsubstituted or substituted phenyl and  
unsubstituted or substituted heteroaryl selected from  
thienyl, furanyl, pyridyl, imidazolyl and pyrazolyl; wherein  
25  $R^2$  is selected from phenyl, isoquinolyl and quinolyl, where  
 $R^2$  is unsubstituted or substituted with one or more  
substituents selected from chloro, fluoro, amino, hydroxy,  
cyclohexyl, phenylmethyl, morpholinylmethyl,  
methylpiperidinylmethyl, methylpiperazinylmethyl, ethyl,

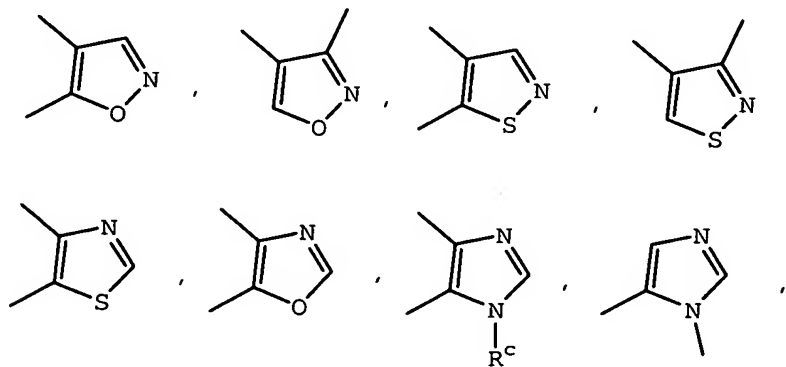
propyl, trifluoromethyl, phenyloxy, methoxy and ethoxy; and wherein  $R^8$  is one or more substituents independently selected from chloro, fluoro, methyl, cyano, amino, hydroxy, aminomethyl, hydroxymethyl, nitro, methoxy and ethoxy; and  
 5 pharmaceutically acceptable salts thereof; provided  $R^8$  is one or more radicals selected from amino, cyano, aminomethyl, hydroxymethyl, hydroxy, methoxy and ethoxy.

A class of compounds useful in treating cancer and  
 10 angiogenesis is defined by Formula I'

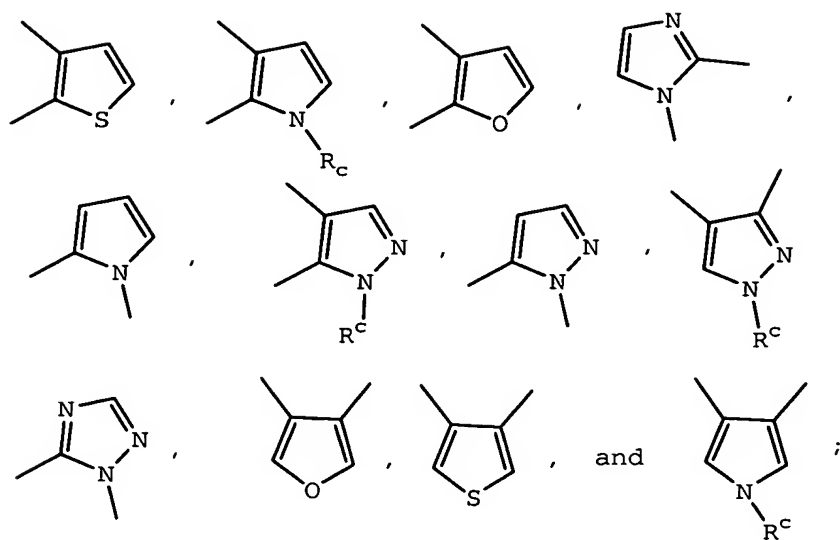


wherein each of  $A^1$  and  $A^2$  is independently C or N;  
 wherein  $A^1$ - $A^2$  form part of a ring A selected from 5- or 6-  
 15 membered heteroaryl,  
 preferably

I) 5-membered heteroaryl selected from thienyl,  
 furanyl, pyrrolyl, thiazolyl, oxazolyl, imidazolyl,  
 pyrazolyl, isoxazolyl, triazolyl and isothiazolyl,  
 20 even more preferably 5-membered heteroaryl selected  
 from

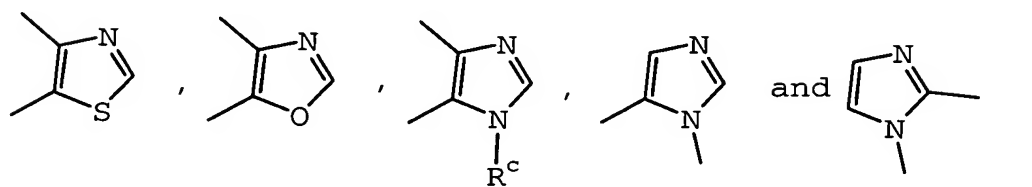






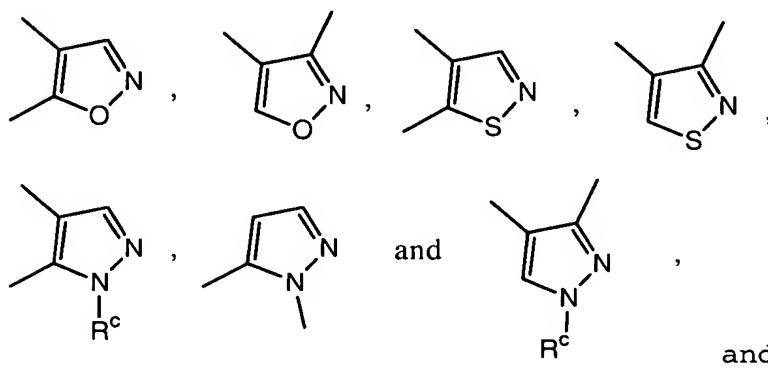
specifically

A)



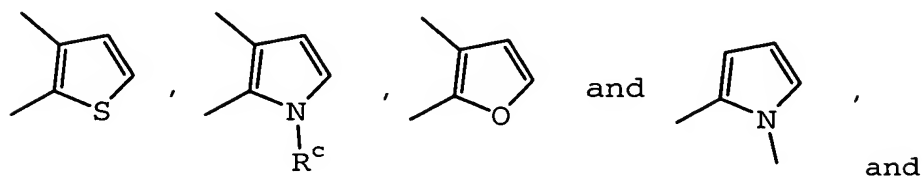
5

B)



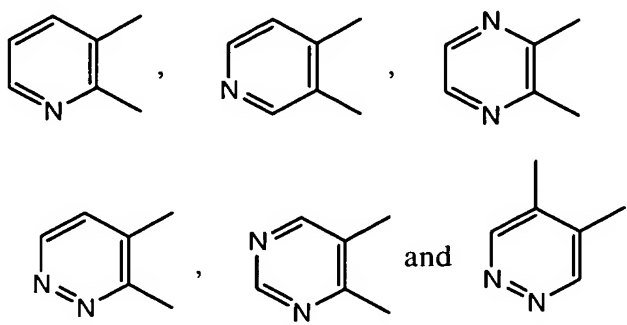
10

C)

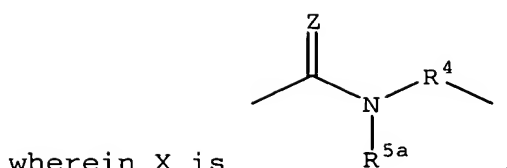
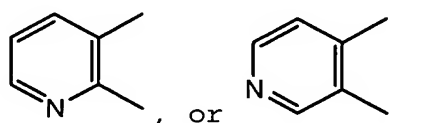


II) preferably 6-membered heteroaryl selected from pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, and triazinyl,

even more preferably 6-membered heteroaryl selected from

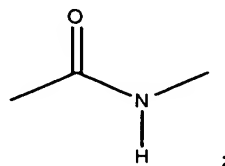
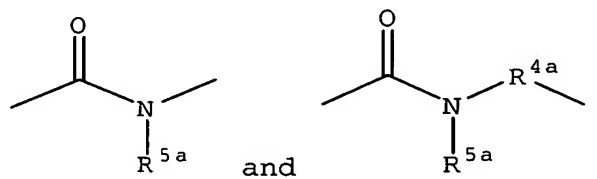


specifically, pyridyl and pyrimidinyl, more specifically



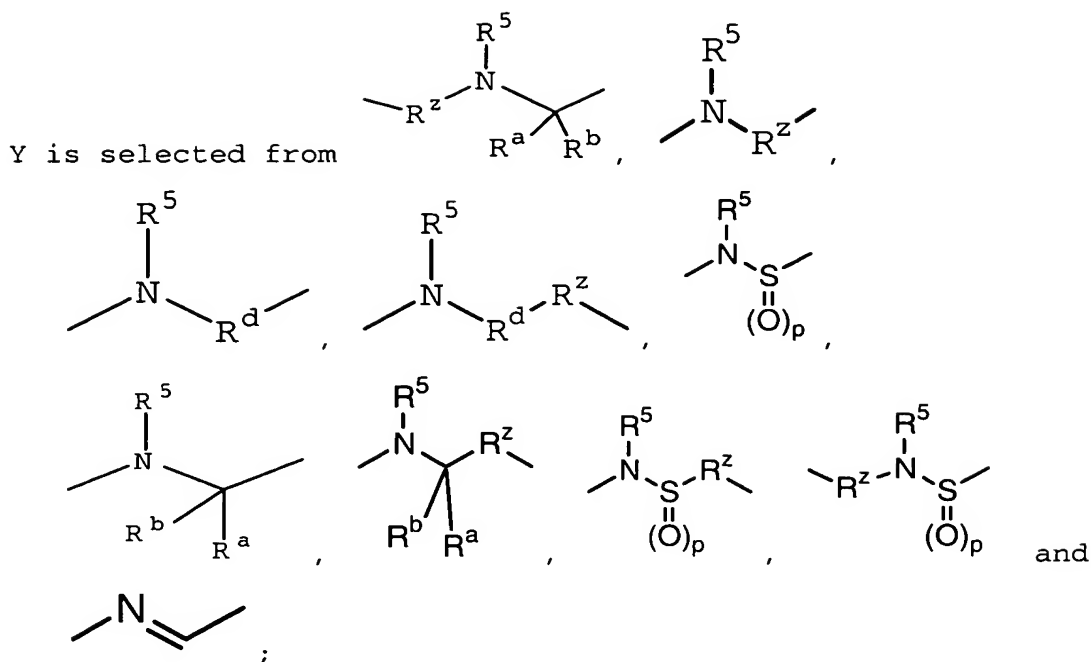
wherein X is

preferably X is

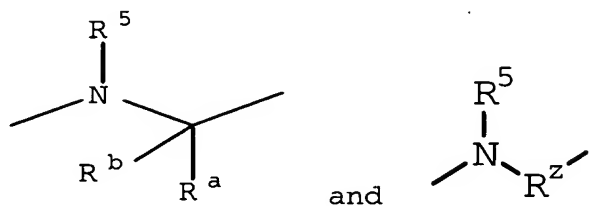


more preferably X is

wherein Z is oxygen or sulfur;



5



more preferably -NH-CH<sub>2</sub>-;

wherein p is 0 to 2,

preferably 2;

- 10 wherein R<sup>a</sup> and R<sup>b</sup> are independently selected from H, halo, cyano, -NHR<sup>6</sup> and C<sub>1-4</sub>-alkyl substituted with R<sup>1</sup>, or wherein R<sup>a</sup> and R<sup>b</sup> together form C<sub>3</sub>-C<sub>6</sub> cycloalkyl; preferably H, halo, and C<sub>1-2</sub>-alkyl substituted with R<sup>1</sup>, or wherein R<sup>a</sup> and R<sup>b</sup> together form C<sub>3</sub>-C<sub>4</sub> cycloalkyl,
- 15 more preferably H, chloro, fluoro and C<sub>1</sub>-C<sub>2</sub>-alkyl, even more preferably H;

wherein R<sup>z</sup> is selected from C<sub>2</sub>-C<sub>6</sub>-alkylenyl, where one of the CH<sub>2</sub> groups may be replaced with an oxygen atom or an -NH- group; wherein one of the CH<sub>2</sub> groups may be substituted

with one or two radicals selected from halo, cyano,  $\text{-NHR}^6$  and  $\text{C}_{1-4}$ -alkyl substituted with  $\text{R}^1$ ; preferably  $\text{C}_2\text{-C}_3$  alkylene, where one of the  $\text{CH}_2$  groups may be replaced with an oxygen atom or an  $\text{-NH-}$ ,  
5 more preferably  $\text{-(CH}_2\text{)}_2\text{-}$ ;  
wherein  $\text{R}^d$  is optionally substituted cycloalkyl, preferably  $\text{C}_{3-6}$ -cycloalkyl;  
wherein  $\text{R}^1$  is one or more substituents independently selected from H, halo,  $\text{-OR}^7$ , oxo,  $\text{-SR}^7$ ,  $\text{-CO}_2\text{R}^7$ ,  $\text{-COR}^7$ ,  $\text{-CONR}^7\text{R}^7$ ,  
10  $\text{-NR}^7\text{R}^7$ ,  $\text{-SO}_2\text{NR}^7\text{R}^7$ ,  $\text{-NR}^7\text{C(O)OR}^7$ ,  $\text{-NR}^7\text{C(O)R}^7$ , optionally substituted cycloalkyl, optionally substituted phenylalkyl, optionally substituted heterocyclyl, optionally substituted heterocyclylalkyl, optionally substituted phenyl, lower alkyl, cyano, lower  
15 hydroxyalkyl, lower carboxyalkyl, nitro, lower alkenyl, lower alkynyl, lower aminoalkyl, lower alkylaminoalkyl and lower haloalkyl, preferably H, halo,  $\text{-OR}^7$ , oxo,  $\text{-SR}^7$ ,  $\text{-CO}_2\text{R}^7$ ,  $\text{-CONR}^7\text{R}^7$ ,  $\text{-COR}^7$ ,  $\text{-NR}^7\text{R}^7$ ,  $\text{-SO}_2\text{NR}^7\text{R}^7$ ,  $\text{-NR}^7\text{C(O)OR}^7$ ,  $\text{-NR}^7\text{C(O)R}^7$ ,  
20 optionally substituted  $\text{C}_{3-6}$ -cycloalkyl, optionally substituted phenyl- $\text{C}_{1-4}$ -alkyl, optionally substituted 4-6 membered heterocyclyl, optionally substituted phenyl, optionally substituted 4-6 membered heterocyclyl- $\text{C}_{1-4}$ -alkyl,  $\text{C}_{1-6}$ -alkyl, cyano,  $\text{C}_{1-4}$ -  
25 hydroxyalkyl,  $\text{C}_{1-4}$ -carboxyalkyl, nitro,  $\text{C}_{2-3}$ -alkenyl,  $\text{C}_{2-3}$ -alkynyl and  $\text{C}_{1-4}$ -haloalkyl,  
more preferably H, halo, hydroxy,  $\text{C}_{1-2}$ -alkoxy,  $\text{C}_{1-2}$ -haloalkoxy, amino,  $\text{C}_{1-2}$ -alkylamino, optionally substituted 4-6 membered heterocyclyl- $\text{C}_{1-2}$ -alkylamino, aminosulfonyl,  $\text{C}_{3-6}$ -cycloalkyl,  
30 optionally substituted 4-6 membered heterocyclyl, optionally substituted phenyl,  $\text{C}_{1-4}$ -alkyl, cyano,  $\text{C}_{1-2}$ -hydroxyalkyl,  $\text{C}_{1-3}$ -carboxyalkyl, nitro,  $\text{C}_{2-3}$ -alkenyl,  $\text{C}_{2-3}$ -alkynyl and  $\text{C}_{1-2}$ -haloalkyl, and

- even more preferably H, chloro, fluoro, bromo,  
hydroxy, methoxy, ethoxy, trifluoromethoxy, oxo,  
amino, dimethylamino, aminosulfonyl,  
carboxymethyl, cyclopropyl, optionally  
5 substituted phenyl, methyl, ethyl, propyl, cyano,  
hydroxymethyl, nitro, propenyl, propynyl,  
trifluoromethyl and unsubstituted or substituted  
heteroaryl selected from  
thienyl, furanyl, pyridyl, imidazolyl and  
10 pyrazolyl;  
wherein R<sup>2</sup> is selected from  
a) substituted or unsubstituted 6-10 membered aryl,  
preferably phenyl, naphthyl, benzodioxolyl, indanyl,  
indenyl and tetrahydronaphthyl,  
15 more preferably phenyl, indanyl,  
tetrahydronaphthyl, and naphthyl,  
b) substituted or unsubstituted 5-6 membered  
heterocyclyl,  
preferably 5-6 membered heteroaryl,  
20 more preferably isoxazolyl, pyrazolyl, thiazolyl,  
thiadiazolyl, thienyl, pyridyl, pyrimidinyl,  
pyridazinyl, imidazolyl, oxazolyl, furyl and  
pyrrolyl,  
c) substituted or unsubstituted 9-14 membered bicyclic or  
25 tricyclic heterocyclyl,  
preferably 9-10 membered bicyclic or 13-14 membered  
tricyclic heterocyclyl,  
more preferably indazolyl, indolyl, isoindolyl,  
2,3-dihydro-1H-indolyl, naphthyridinyl, 2,1,3-  
30 benzothiadiazolyl, isoquinolyl, quinolyl, 1,2-  
dihydroquinolyl, 1,2,3,4-tetrahydro-isoquinolyl,  
2,3,4,4a,9,9a-hexahydro-1H-3-aza-fluorenyl,  
5,6,7-trihydro-1,2,4-triazolo[3,4-a]isoquinolyl,  
3,4-dihydro-2H-benzo[1,4]oxazinyl, benzothienyl,

tetrahydroquinolyl, benzofuryl, benzimidazolyl, benzoxazolyl, benzthiazolyl, benzodioxanyl and quinazolinyl,

even more preferably 9-10 membered bicyclic or 13-14 membered tricyclic saturated or partially unsaturated heterocyclyl,

specifically 1,2-dihydroquinolyl, 1,2,3,4-tetrahydro-isoquinolyl, 1,2,3,4-tetrahydro-quinolyl, 2,3-dihydro-1H-indolyl, 2,3,4,4a,9,9a-hexahydro-1H-3-aza-fluorenyl, 5,6,7-trihydro-1,2,4-triazolo[3,4-a]isoquinolyl, 3,4-dihydro-2H-benzo[1,4]oxazinyl, and benzo[1,4]dioxanyl;

d) cycloalkyl,

preferably C<sub>3-6</sub>-cycloalkyl,

more preferably cyclohexyl, and

e) cycloalkenyl,

wherein substituted R<sup>2</sup> is substituted with one or more

substituents independently selected from halo, -OR<sup>7</sup>,

oxo, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -NH(C<sub>1</sub>-C<sub>4</sub>alkylenylR<sup>9</sup>), -SO<sub>2</sub>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>,

-NR<sup>7</sup>C(O)NR<sup>7</sup>R<sup>7</sup>, optionally substituted cycloalkyl,

optionally substituted heterocyclyl, optionally

substituted phenyl, halosulfonyl, cyano,

alkylaminoalkoxy, alkylaminoalkoxyalkoxy, nitro, lower

alkyl substituted with R<sup>1</sup>, lower alkenyl substituted

with R<sup>1</sup>, and lower alkynyl substituted with R<sup>1</sup>,

preferably halo, -OR<sup>7</sup>, oxo, -SR<sup>7</sup>, -SO<sub>2</sub>R<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>,

-CONR<sup>7</sup>R<sup>7</sup>, -COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -NH(C<sub>1</sub>-C<sub>2</sub>-alkylenylR<sup>9</sup>),

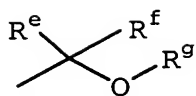
-(C<sub>1</sub>-C<sub>2</sub>-alkylenyl)NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>,

-NR<sup>7</sup>C(O)R<sup>7</sup>, C<sub>1</sub>-C<sub>6</sub>-alkylamino-C<sub>1</sub>-C<sub>6</sub>-alkoxy, C<sub>1</sub>-C<sub>6</sub>-

alkylamino-C<sub>1</sub>-C<sub>6</sub>-alkoxy-C<sub>1</sub>-C<sub>6</sub>-alkoxy, halosulfonyl,

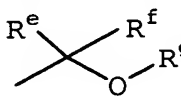
optionally substituted 4-6 membered heterocyclyl-

carbonylalkyl, C<sub>1-4</sub>-alkoxycarbonylamino-C<sub>1-6</sub>-alkyl,



, optionally substituted C<sub>3-6</sub>-cycloalkyl, optionally substituted 4-6 membered heterocyclyl, optionally substituted phenyl, optionally substituted phenyl-C<sub>1-6</sub>-alkylenyl, optionally substituted 4-6 membered heterocyclyl-C<sub>1-6</sub>-alkylenyl, 4-6 membered heterocyclyl-C<sub>2-6</sub>-alkenylenyl, C<sub>1-4</sub>-alkyl, cyano, C<sub>1-4</sub>-hydroxyalkyl, nitro and C<sub>1-4</sub>-haloalkyl, more preferably halo, C<sub>1-4</sub>-alkyl, optionally substituted C<sub>3-6</sub>-cycloalkyl, optionally substituted phenyl, optionally substituted phenyl-C<sub>1-4</sub>-alkylenyl, C<sub>1-2</sub>-haloalkoxy, optionally substituted phenyloxy, optionally substituted 4-6 membered heterocyclyl-C<sub>1-4</sub>-alkylenyl, optionally substituted 4-6 membered heterocyclyl-C<sub>2-4</sub>-alkenylenyl, optionally substituted 4-6 membered heterocyclyl, optionally substituted 4-6 membered heterocycliloxy, optionally substituted 4-6 membered heterocyclylsulfonyl, optionally substituted 4-6 membered heterocyclylamino, optionally substituted 4-6 membered heterocyclylcarbonyl, optionally substituted 4-6 membered heterocyclyl-C<sub>1-4</sub>-alkylcarbonyl, C<sub>1-2</sub>-haloalkyl, C<sub>1-4</sub>-aminoalkyl, nitro, amino, hydroxy, cyano, aminosulfonyl, C<sub>1-2</sub>-alkylsulfonyl, halosulfonyl, C<sub>1-4</sub>-alkylcarbonyl, C<sub>1-3</sub>-alkylamino-C<sub>1-3</sub>-alkyl, C<sub>1-3</sub>-alkylamino-C<sub>1-3</sub>-alkoxy, C<sub>1-3</sub>-alkylamino-C<sub>1-3</sub>-alkoxy-C<sub>1-3</sub>-alkoxy, C<sub>1-4</sub>-alkoxycarbonyl, C<sub>1-4</sub>-

alkoxycarbonylamino-C<sub>1-4</sub>-alkyl, C<sub>1-4</sub>-

hydroxyalkyl,  and C<sub>1-4</sub>-alkoxy, even more preferably bromo, chloro, fluoro, iodo, nitro, amino, cyano, aminoethyl, Boc-aminoethyl, hydroxy, aminosulfonyl, 4-methylpiperazinylsulfonyl, cyclohexyl, phenyl, phenylmethyl, morpholinylmethyl, methylpiperazinylmethyl, morpholinylethyl, methylpiperazinylpropyl, 1-(4-morpholinyl)-2,2-dimethylpropyl, piperidinylmethyl, morpholinylpropyl, methylpiperidinylmethyl, piperidinylethyl, piperidinylpropyl, pyrrolidinylpropyl, pyrrolidinylpropenyl, pyrrolidinylbutenyl, fluorosulfonyl, methylsulfonyl, methylcarbonyl, piperidinylmethylcarbonyl, methylpiperazinylcarbonylethyl, methoxycarbonyl, 3-ethoxycarbonyl-2-methylfur-5-yl, methylpiperazinyl, methylpiperidyl, 1-methyl-(1,2,3,6-tetrahydropyridyl), imidazolyl, morpholinyl, 4-trifluoromethyl-1-piperidinyl, hydroxybutyl, methyl, ethyl, propyl, isopropyl, butyl, tert-butyl, sec-butyl, trifluoromethyl, pentafluoroethyl, nonafluorobutyl, dimethylaminopropyl, 1,1-di(trifluoromethyl)-1-hydroxymethyl, trifluoromethoxy, 1,1-di(trifluoromethyl)-1-(piperidinylethoxy)methyl, 1,1-di(trifluoromethyl)-1-(methoxyethoxyethoxy)methyl, 1-hydroxyethyl, 2-hydroxyethyl, 1-aminoethyl, 2-aminoethyl, 1-(N-isopropylamino)ethyl, 2-

1004536-01003  
2004-03-24



(N-isopropylamino)ethyl,  
dimethylaminoethoxy, 4-chlorophenoxy,  
phenyloxy, 1-methylpiperidin-4-yloxy,  
isopropoxy, methoxy and ethoxy;

5 wherein R<sup>3</sup> is selected from unsubstituted or substituted  
aryl,

preferably substituted phenyl,

wherein substituted R<sup>3</sup> is substituted with one or more  
substituents independently selected from halo, -OR<sup>7</sup>,

10 -SR<sup>7</sup>, -SO<sub>2</sub>R<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -COR<sup>7</sup>, -NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>,  
-NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, cycloalkyl, optionally  
substituted heterocyclyl, optionally substituted  
phenyl, nitro, alkylaminoalkoxyalkoxy, cyano,  
alkylaminoalkoxy, lower alkyl substituted with R<sup>1</sup>,  
15 lower alkenyl substituted with R<sup>1</sup>, and lower alkynyl  
substituted with R<sup>1</sup>;

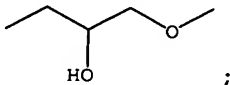
preferably halo, -OR<sup>7</sup>, -SR<sup>7</sup>, -CO<sub>2</sub>R<sup>7</sup>, -CONR<sup>7</sup>R<sup>7</sup>, -COR<sup>7</sup>,  
-NR<sup>7</sup>R<sup>7</sup>, -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup>, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, C<sub>3-6</sub>-

20 cycloalkyl, optionally substituted 4-6 membered  
heterocyclyl, optionally substituted phenyl, C<sub>1-4</sub>-  
alkyl, C<sub>1-4</sub>-aminoalkyl, cyano, C<sub>1-4</sub>-hydroxyalkyl,  
nitro and C<sub>1-4</sub>-haloalkyl,

more preferably halo, hydroxy, C<sub>1-4</sub>-alkyl, C<sub>1-2</sub>-  
alkoxy, optionally substituted 4-6 membered

25 heterocyclyl-C<sub>1-2</sub>-alkoxy, amino, C<sub>1-2</sub>-alkylamino,  
aminosulfonyl, -NR<sup>7</sup>C(O)OR<sup>7</sup>, -NR<sup>7</sup>C(O)R<sup>7</sup>, C<sub>3-6</sub>-  
cycloalkyl, optionally substituted 4-6 membered  
heterocyclyl, optionally substituted phenyl,

30 nitro, C<sub>1-2</sub>-alkylamino-C<sub>1-2</sub>-alkoxy-C<sub>1-2</sub>-alkoxy,  
cyano, C<sub>1-2</sub>-alkylamino-C<sub>1-2</sub>-alkoxy, C<sub>1-2</sub>-alkylamino-  
C<sub>1-2</sub>-alkyl, C<sub>1-2</sub>-alkylamino-C<sub>2-3</sub>-alkynyl, C<sub>1-2</sub>-  
hydroxyalkyl, C<sub>1-2</sub>-aminoalkyl, C<sub>1-2</sub>-haloalkyl,  
optionally substituted 4-6 membered heterocyclyl-

- C<sub>2-3</sub>-alkenyl, and optionally substituted 4-6  
 membered heterocycl-yl-C<sub>2-3</sub>-alkynyl,  
 even more preferably chloro, fluoro, bromo,  
 hydroxy, methoxy, ethoxy, amino,  
 5 dimethylamino, diethylamino, 1-  
 methylpiperidinylmethoxy, aminosulfonyl,  
 cyclohexyl, dimethylaminopropynyl,  
 dimethylaminoethoxy, 3-(4-morpholinyl)propyn-  
 1-yl, dimethylaminoethoxyethoxy, optionally  
 10 substituted piperidinyl, morpholinyl,  
 optionally substituted piperazinyl, optionally  
 substituted phenyl, methyl, ethyl, propyl,  
 cyano, hydroxymethyl, aminomethyl, nitro and  
 trifluoromethyl;  
 15 wherein R<sup>4</sup> is independently selected from a direct bond, C<sub>2-4</sub>-  
 alkylenyl, C<sub>2-4</sub>-alkenylenyl and C<sub>2-4</sub>-alkynylenyl, where  
 one of the CH<sub>2</sub> groups may be substituted with an oxygen  
 atom or -NH-, wherein R<sup>4</sup> is optionally substituted with  
 hydroxy,  
 20 preferably a direct bond or R<sup>4a</sup>;  
 wherein R<sup>4a</sup> is selected from C<sub>2-4</sub>-alkylenyl where one of the  
 CH<sub>2</sub> groups may be replaced with an oxygen atom or -NH-,  
 wherein R<sup>4a</sup> is optionally substituted with hydroxy,  
 preferably ethyl, butyl, and  ;  
 25 wherein R<sup>5</sup> is selected from H, lower alkyl, phenyl and lower  
 aralkyl,  
 preferably H, methyl or ethyl,  
 more preferably H;  
 wherein R<sup>5a</sup> is selected from H, lower alkyl, phenyl and  
 30 lower aralkyl,  
 preferably H, methyl or ethyl,  
 more preferably H;  
 wherein R<sup>6</sup> is selected from H or C<sub>1-6</sub>-alkyl,

preferably H or C<sub>1-2</sub> alkyl;

wherein R<sup>7</sup> is selected from H, lower alkyl, optionally substituted phenyl, optionally substituted heterocyclyl, optionally substituted C<sub>3</sub>-C<sub>6</sub>-cycloalkyl, optionally substituted phenyl-C<sub>1-6</sub>-alkyl, optionally substituted heterocyclyl-C<sub>1-6</sub>-alkyl, optionally substituted C<sub>3</sub>-C<sub>6</sub> cycloalkyl-C<sub>1-6</sub>-alkyl, lower alkylaminoalkyl, and lower haloalkyl,

preferably H, C<sub>1-4</sub>-alkyl, optionally substituted phenyl, optionally substituted phenyl-C<sub>1-4</sub>-alkyl, optionally substituted 4-6 membered heterocyclyl, optionally substituted 4-6 membered heterocyclyl-C<sub>1-4</sub>-alkyl, optionally substituted C<sub>3</sub>-C<sub>6</sub> cycloalkyl, C<sub>1-2</sub>-alkylamino-C<sub>1-4</sub>-alkyl and C<sub>1-2</sub>-haloalkyl, more preferably H, methyl, phenyl, cyclopropyl, cyclohexyl, benzyl, morpholinylmethyl, 4-methylpiperazinylmethyl, 4-methylpiperdinylmethyl, 4-morpholinylmethyl, 4-morpholinylethyl, 1-(4-morpholinyl)-2,2-dimethylpropyl, 1-piperdinyldethyl, 1-piperdinyldpropyl, 1-pyrrolidinylpropyl and trifluoromethyl;

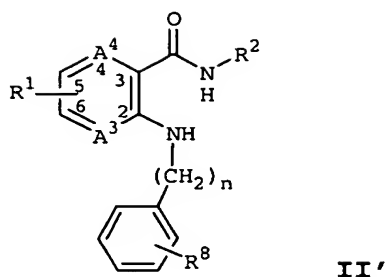
wherein R<sup>c</sup> is selected from H, methyl and optionally substituted phenyl; and

wherein R<sup>e</sup> and R<sup>f</sup> are independently selected from H and C<sub>1-2</sub>-haloalkyl, preferably -CF<sub>3</sub>;

wherein R<sup>g</sup> is selected from H, C<sub>1-6</sub>-alkyl, optionally substituted phenyl-C<sub>1-6</sub>-alkyl, optionally substituted 4-6 membered heterocyclyl, optionally substituted 4-6 membered heterocyclyl-C<sub>1-6</sub>-alkyl, C<sub>1-4</sub>-alkoxy-C<sub>1-4</sub>-alkyl and C<sub>1-4</sub>-alkoxy-C<sub>1-4</sub>-alkoxy-C<sub>1-4</sub>-alkyl, preferably H, C<sub>1-3</sub>-alkyl, optionally substituted phenyl-C<sub>1-3</sub>-alkyl, optionally substituted 4-6 membered heterocyclyl-C<sub>1-3</sub>-alkyl, C<sub>1-3</sub>-alkoxy-C<sub>1-3</sub>-alkyl and C<sub>1-3</sub>-alkoxy-C<sub>1-3</sub>-alkoxy-C<sub>1-3</sub>-alkyl; and

- wherein R<sup>9</sup> is selected from H, optionally substituted phenyl, optionally substituted 4-6 membered heterocyclyl and C<sub>3</sub>-C<sub>6</sub> cycloalkyl;  
provided R<sup>2</sup> is not 3-trifluoromethylphenyl when A is
- 5        pyridyl, when X is -C(O)NH-, when Y is -NH-CH<sub>2</sub>-, when R<sup>1</sup> is H and R<sup>3</sup> is 3-(N-methylamino-carbonyl)phenyl, 4-hydroxyphenyl, 3-hydroxyphenyl or phenyl;  
further provided R<sup>2</sup> is not substituted with -SO<sub>2</sub>NR<sup>7</sup>R<sup>7</sup> when Y is -NHSO<sub>2</sub>-;
- 10    further provided R<sup>2</sup> is not 3-trifluoromethylphenyl when A is pyridyl, when X is -C(O)NH-, when Y is -N(benzyl)-CH<sub>2</sub>-, when R<sup>1</sup> is H and when R<sup>3</sup> is phenyl;  
further provided R<sup>2</sup> is not cyclohexyl when A is pyridyl, when X is -C(O)NH-, when Y is -NH-CH<sub>2</sub>-, when R<sup>1</sup> is H
- 15        and when R<sup>3</sup> is 2-methoxyphenyl or 3-methoxyphenyl;  
further provided R<sup>1</sup> is not 2-hydroxymethylpyrrol-5-yl when A is pyridyl;  
further provided R<sup>1</sup> is not 4-(methoxyaminocarbonylamino)phenyl when A is thienyl;
- 20    further provided R<sup>1</sup> is not 2-pyridylmethoxy when A is pyrimidyl, when X is -C(O)NH-, and when Y is -NH-CH<sub>2</sub>-;  
further provided R<sup>1</sup> is not 4-methylpiperidyl when A is pyrimidyl, when X is -C(O)NH-, when Y is -NH-CH<sub>2</sub>-, and when R<sup>3</sup> is 3-chloro-4-methoxyphenyl;
- 25    further provided R<sup>1</sup> is not bromo when A is pyrimidyl, when X is -C(O)NH-CH<sub>2</sub>-, when Y is -NH-CH<sub>2</sub>-, and when R<sup>3</sup> is 3-chloro-4-methoxyphenyl;  
further provided R<sup>2</sup> is not 2-chloro-3-pyridyl when A is pyridyl; and
- 30    further provided R<sup>2</sup> is not 2-methoxyphenyl when A is pyridyl, when X is -C(O)NH-, when Y is -NH-CH<sub>2</sub>-, when R<sup>1</sup> is H and R<sup>3</sup> is phenyl.

The invention also relates to compounds of Formula II'



wherein each of A<sup>3</sup> and A<sup>4</sup> is independently CH or N, provided  
at least one of A<sup>3</sup> and A<sup>4</sup> is N;

5 wherein n is 1-2;

wherein R<sup>1</sup> is one or more substituents independently  
selected from H, chloro, fluoro, bromo, hydroxy, methoxy,  
ethoxy, trifluoromethoxy, oxo, amino, dimethylamino,  
aminosulfonyl, carboxymethyl, cyclopropyl, optionally  
10 substituted phenyl, methyl, ethyl, propyl, cyano,  
hydroxymethyl, nitro, propenyl, propynyl,  
morpholinylethylamino, trifluoromethyl and unsubstituted  
or substituted heteroaryl selected from thienyl, furanyl,  
pyridyl, imidazolyl and pyrazolyl;

15 wherein R<sup>2</sup> is a substituted or unsubstituted ring selected  
from phenyl, tetrahydronaphthyl, indanyl, benzodioxolyl,  
indenyl, naphthyl, isoxazolyl, pyrazolyl, thiazolyl,  
thiadiazolyl, thienyl, pyridyl, pyrimidinyl, pyridazinyl,  
1,2-dihydroquinolyl, 1,2,3,4-tetrahydro-isoquinolyl,  
20 1,2,3,4-tetrahydro-quinolyl, isoquinolyl, quinolyl,  
indolyl, isoindolyl, 2,3-dihydro-1H-indolyl,  
naphthyridinyl, quinoxalinyl, 2,3,4,4a,9,9a-hexahydro-1H-  
3-aza-fluorenyl, 5,6,7-trihydro-1,2,4-triazolo[3,4-  
a]isoquinolyl, indazolyl, 2,1,3-benzothiadiazolyl, 3,4-  
25 dihydro-2H-benzo[1,4]oxazinyl, benzodioxanyl,  
benzothienyl, benzofuryl, benzimidazolyl, benzoxazolyl  
and benzthiazolyl;

wherein substituted R<sup>2</sup> is substituted with one or more  
substituents independently selected from bromo,

chloro, fluoro, iodo, nitro, amino, cyano, aminoethyl, Boc-aminoethyl, hydroxy, oxo, aminosulfonyl, 4-methylpiperazinylsulfonyl, cyclohexyl, phenyl, phenylmethyl, morpholinylmethyl, 1-methylpiperazin-4-ylmethyl, 1-methylpiperazin-4-ylpropyl, morpholinylpropyl, piperidin-1-ylmethyl, 1-methylpiperidin-4-ylmethyl, 2-methyl-2-(1-methylpiperidin-4-yl)ethyl, morpholinylethyl, 1-(4-morpholinyl)-2,2-dimethylpropyl, piperidin-4-ylethyl, 1-Boc-piperidin-4-ylethyl, piperidin-1-ylethyl, 1-Boc-piperidin-4-ylethyl, piperidin-4-ylmethyl, 1-Boc-piperidin-4-ylmethyl, piperidin-4-ylpropyl, 1-Boc-piperidin-4-ylpropyl, piperidin-1-ylpropyl, pyrrolidin-1-ylpropyl, pyrrolidin-2-ylpropyl, 1-Boc-pyrrolidin-2-ylpropyl, pyrrolidin-1-ylmethyl, pyrrolidin-2-ylmethyl, 1-Boc-pyrrolidin-2-ylmethyl, pyrrolidinylpropenyl, pyrrolidinylbutenyl, fluorosulfonyl, methylsulfonyl, methylcarbonyl, Boc, piperidin-1-ylmethylcarbonyl, 4-methylpiperazin-1-ylcarbonylethyl, methoxycarbonyl, aminomethylcarbonyl, dimethylaminomethylcarbonyl, 3-ethoxycarbonyl-2-methyl-fur-5-yl, 4-methylpiperazin-1-yl, 4-methyl-1-piperidyl, 1-Boc-4-piperidyl, piperidin-4-yl, 1-methylpiperidin-4-yl, 1-methyl-(1,2,3,6-tetrahydropyridyl), imidazolyl, morpholinyl, 4-trifluoromethyl-1-piperidinyl, hydroxybutyl, methyl, ethyl, propyl, isopropyl, butyl, tert-butyl, sec-butyl, trifluoromethyl, pentafluoroethyl, nonafluorobutyl, dimethylaminopropyl, 1,1-di(trifluoromethyl)-1-hydroxymethyl, 1,1-di(trifluoromethyl)-1-(piperidinylethoxy)methyl, 1,1-di(trifluoromethyl)-1-(methoxyethoxyethoxy)methyl, 1-hydroxyethyl, 2-hydroxyethyl, trifluoromethoxy, 1-aminoethyl, 2-aminoethyl, 1-(N-isopropylamino)ethyl,

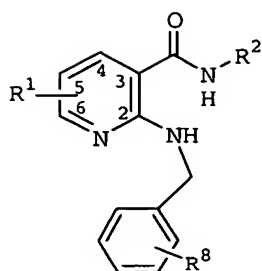
2-(N-isopropylamino)ethyl, dimethylaminoethoxy, 4-chlorophenoxy, phenyloxy, azetidin-3-ylmethoxy, 1-Boc-azetidin-3-ylmethoxy, pyrrol-2-ylmethoxy, 1-Boc-pyrrol-2-ylmethoxy, pyrrol-1-ylmethoxy, 1-methyl-pyrrol-2-ylmethoxy, 1-isopropyl-pyrrol-2-ylmethoxy, 1-Boc-piperdin-4-ylmethoxy, piperdin-4-ylmethoxy, 1-methylpiperdin-4-yloxy, isopropoxy, methoxy and ethoxy; and

wherein R<sup>8</sup> is one or more substituents independently selected from H, chloro, fluoro, bromo, hydroxy, methoxy, ethoxy, -O-CH<sub>2</sub>-O-, trifluoromethoxy, 1-methylpiperidinylmethoxy, dimethylaminoethoxy, amino, dimethylamino, dimethylaminopropyl, diethylamino, aminosulfonyl, cyclohexyl, dimethylaminopropynyl, 3-(4-morpholinyl)propyn-1-yl, dimethylaminoethoxyethoxy, 3-(4-morpholinyl)propylamino, optionally substituted piperidinyl, morpholinyl, optionally substituted piperazinyl, optionally substituted phenyl, methyl, ethyl, propyl, cyano, hydroxymethyl, aminomethyl, nitro and trifluoromethyl;

provided R<sup>2</sup> is not 3-trifluoromethylphenyl when A<sup>3</sup> is N, when A<sup>4</sup> is CH, when n is 1, when R<sup>1</sup> is H and R<sup>8</sup> is 4-hydroxy, 3-hydroxy or H; further provided R<sup>2</sup> is not 2-chloro-3-pyridyl when A<sup>3</sup> is N, when A<sup>4</sup> is CH, when n is 1, when R<sup>1</sup> is H and R<sup>8</sup> is H or 4-methoxy; and further provided R<sup>2</sup> is not 2-methoxyphenyl when A<sup>3</sup> is N, when A<sup>4</sup> is CH, when n is 1, when R<sup>1</sup> is H and R<sup>8</sup> is H.

The invention also relates to compounds of Formula III

30

**III**

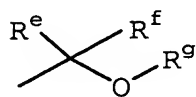
wherein R<sup>1</sup> is one or more substituents independently  
selected from

- 5                   H,  
                  halo,  
                  hydroxy,  
                  amino,  
                  C<sub>1-6</sub>-alkyl,  
10                  C<sub>1-6</sub>-haloalkyl,  
                  C<sub>1-6</sub>-alkoxy,  
                  C<sub>1-2</sub>-alkylamino,  
                  aminosulfonyl,  
                  C<sub>3-6</sub>-cycloalkyl,  
15                  cyano,  
                  oxo,  
                  C<sub>1-2</sub>-hydroxyalkyl,  
                  nitro,  
                  C<sub>2-3</sub>-alkenyl,  
20                  C<sub>2-3</sub>-alkynyl,  
                  C<sub>1-6</sub>-haloalkoxy,  
                  C<sub>1-6</sub>-carboxyalkyl,  
                  5-6-membered heterocyclyl-C<sub>1-6</sub>-alkylamino,  
                  unsubstituted or substituted phenyl and  
25                  unsubstituted or substituted 4-6 membered  
                  heterocyclyl,  
preferably H, chloro, fluoro, bromo, amino, hydroxy,  
methyl, ethyl, propyl, oxo, dimethylamino,  
aminosulfonyl, cyclopropyl, cyano, hydroxymethyl,



nitro, propenyl, trifluoromethyl, methoxy, ethoxy,  
trifluoromethoxy, carboxymethyl,  
morpholinylethylamino, propynyl, unsubstituted or  
substituted phenyl and unsubstituted or substituted  
5 heteroaryl selected from thienyl,  
furanyl, pyridyl, imidazolyl, and pyrazolyl,  
more preferably H, chloro or fluoro;  
wherein R<sup>2</sup> is selected from unsubstituted or substituted  
phenyl, and  
10 9-10 membered bicyclic and 13-14 membered tricyclic  
unsaturated or partially unsaturated heterocyclyl,  
preferably phenyl, 1,2-dihydroquinolyl, 1,2,3,4-  
tetrahydro-isoquinolyl, 1,2,3,4-tetrahydro-quinolyl,  
2,3-dihydro-1H-indolyl, 2,3,4,4a,9,9a-hexahydro-1H-3-  
15 aza-fluorenyl, 5,6,7-trihydro-1,2,4-triazolo[3,4-  
a]isoquinolyl, 3,4-dihydro-2H-benzo[1,4]oxazinyl, and  
benzo[1,4]dioxanyl,  
more preferably phenyl, 1,2,3,4-tetrahydro-  
isoquinolyl, 1,2,3,4-tetrahydro-quinolyl, 2,3-  
20 dihydro-1H-indolyl and 3,4-dihydro-2H-  
benzo[1,4]oxazinyl;  
wherein substituted R<sup>2</sup> is substituted with one or more  
substituents selected from halo, C<sub>1-6</sub>-alkyl,  
optionally substituted C<sub>3-6</sub>-cycloalkyl, optionally  
25 substituted phenyl, optionally substituted phenyl-  
C<sub>1</sub>-C<sub>4</sub>-alkylenyl, C<sub>1-2</sub>-haloalkoxy, optionally  
substituted phenyloxy, optionally substituted 4-6  
membered heterocyclyl-C<sub>1</sub>-C<sub>4</sub>-alkyl, optionally  
substituted 4-6 membered heterocyclyl-C<sub>2</sub>-C<sub>4</sub>-alkenyl,  
30 optionally substituted 4-6 membered heterocyclyl,  
optionally substituted 4-6 membered  
heterocycliloxy, optionally substituted 4-6  
membered heterocyclyl-C<sub>1</sub>-C<sub>4</sub>-alkoxy, optionally  
substituted 4-6 membered heterocyclylsulfonyl,

optionally substituted 4-6 membered  
 heterocyclamino, optionally substituted 4-6  
 membered heterocyclcarbonyl, optionally  
 substituted 5-6 membered heterocyclcarbonyl-C<sub>1-4</sub>-  
 alkyl, optionally substituted 4-6 membered  
 heterocycl-C<sub>1-4</sub>-alkylcarbonyl, C<sub>1-2</sub>-haloalkyl, C<sub>1-4</sub>-  
 aminoalkyl, nitro, amino, hydroxy, cyano,  
 aminosulfonyl, C<sub>1-2</sub>-alkylsulfonyl, halosulfonyl, C<sub>1-4</sub>-  
 alkylcarbonyl, C<sub>1-3</sub>-alkylamino-C<sub>1-3</sub>-alkyl, C<sub>1-3</sub>-  
 alkylamino-C<sub>1-3</sub>-alkoxy, C<sub>1-3</sub>-alkylamino-C<sub>1-3</sub>-alkoxy-C<sub>1</sub>-  
 alkoxy, C<sub>1-4</sub>-alkoxycarbonyl, C<sub>1-4</sub>-  
 alkoxycarbonylamino-C<sub>1-4</sub>-alkyl, C<sub>1-4</sub>-hydroxyalkyl,



and C<sub>1-4</sub>-alkoxy,

preferably bromo, chloro, fluoro, iodo, nitro, amino,  
 cyano, aminoethyl, Boc-aminoethyl, hydroxy, oxo,  
 aminosulfonyl, 4-methylpiperazinylsulfonyl,  
 cyclohexyl, phenyl, phenylmethyl,  
 morpholinylmethyl, 1-methylpiperazin-4-ylmethyl, 1-  
 methylpiperazin-4-ylpropyl, morpholinylpropyl,  
 piperidin-1-ylmethyl, 1-methylpiperidin-4-ylmethyl,  
 2-methyl-2-(1-methylpiperidin-4-yl)ethyl,  
 morpholinylethyl, 1-(4-morpholinyl)-2,2-  
 dimethylpropyl, piperidin-4-ylethyl, 1-Boc-  
 piperidin-4-ylethyl, piperidin-1-ylethyl, 1-Boc-  
 piperidin-4-ylethyl, piperidin-4-ylmethyl, 1-Boc-  
 piperidin-4-ylmethyl, piperidin-4-ylpropyl, 1-Boc-  
 piperidin-4-ylpropyl, piperidin-1-ylpropyl,  
 pyrrolidin-1-ylpropyl, pyrrolidin-2-ylpropyl, 1-  
 Boc-pyrrolidin-2-ylpropyl, pyrrolidin-1-ylmethyl,  
 pyrrolidin-2-ylmethyl, 1-Boc-pyrrolidin-2-ylmethyl,  
 pyrrolidinylpropenyl, pyrrolidinylbutenyl,  
 fluorosulfonyl, methylsulfonyl, methylcarbonyl,  
 Boc, piperidin-1-ylmethylcarbonyl, 4-

methylnpiperazin-1-ylcarbonylethyl, methoxycarbonyl,  
aminomethylcarbonyl, dimethylaminomethylcarbonyl,  
3-ethoxycarbonyl-2-methyl-fur-5-yl, 4-  
methylnpiperazin-1-yl, 4-methyl-1-piperidyl, 1-Boc-  
4-piperidyl, piperidin-4-yl, 1-methylnpiperidin-4-  
yl, 1-methyl-(1,2,3,6-tetrahydropyridyl),  
imidazolyl, morpholinyl, 4-trifluoromethyl-1-  
piperidinyl, hydroxybutyl, methyl, ethyl, propyl,  
isopropyl, butyl, tert-butyl, sec-butyl,  
trifluoromethyl, pentafluoroethyl, nonafluorobutyl,  
dimethylaminopropyl, 1,1-di(trifluoromethyl)-1-  
hydroxymethyl, 1,1-di(trifluoromethyl)-1-  
(piperidinylethoxy)methyl, 1,1-di(trifluoromethyl)-  
1-(methoxyethoxyethoxy)methyl, 1-hydroxyethyl, 2-  
hydroxyethyl, trifluoromethoxy, 1-aminoethyl, 2-  
aminoethyl, 1-(N-isopropylamino)ethyl, 2-(N-  
isopropylamino)ethyl, dimethylaminoethoxy, 4-  
chlorophenoxy, phenyloxy, azetidin-3-ylmethoxy, 1-  
Boc-azetidin-3-ylmethoxy, pyrrol-2-ylmethoxy, 1-  
Boc-pyrrol-2-ylmethoxy, pyrrol-1-ylmethoxy, 1-  
methyl-pyrrol-2-ylmethoxy, 1-isopropyl-pyrrol-2-  
ylmethoxy, 1-Boc-piperidin-4-ylmethoxy, piperidin-4-  
ylmethoxy, 1-methylnpiperidin-4-yloxy, isopropoxy,  
methoxy and ethoxy,  
more preferably bromo, chloro, fluoro,  
morpholinylmethyl, 1-methylnpiperazin-4-ylmethyl,  
1-methylnpiperazin-4-ylpropyl, morpholinylpropyl,  
piperidin-1-ylmethyl, 1-methylnpiperidin-4-  
ylmethyl, 2-methyl-2-(1-methylnpiperidin-4-  
yl)ethyl, morpholinylethyl, 1-(4-morpholinyl)-  
2,2-dimethylpropyl, piperidin-4-ylethyl, 1-Boc-  
piperidin-4-ylethyl, piperidin-1-ylethyl, 1-Boc-  
piperidin-4-ylethyl, piperidin-4-ylmethyl, 1-Boc-  
piperidin-4-ylmethyl, piperidin-4-ylpropyl, 1-

Boc-piperidin-4-ylpropyl, piperidin-1-ylpropyl, pyrrolidin-1-ylpropyl, pyrrolidin-2-ylpropyl, 1-Boc-pyrrolidin-2-ylpropyl, pyrrolidin-1-ylmethyl, pyrrolidin-2-ylmethyl, 1-Boc-pyrrolidin-2-ylmethyl, 4-methylpiperazin-1-yl, 4-methyl-1-piperidyl, 1-Boc-4-piperidyl, piperidin-4-yl, 1-methyl-(1,2,3,6-tetrahydropyridyl), 1-methyl-piperidin-4-yl, dimethylaminomethylcarbonyl, aminomethylcarbonyl, methylcarbonyl, methyl, ethyl, propyl, isopropyl, butyl, tert-butyl, sec-butyl, trifluoromethyl, pentafluoroethyl, dimethylaminopropyl, dimethylaminoethoxy, 4-chlorophenoxy, phenyloxy, azetidin-3-ylmethoxy, 1-Boc-azetidin-3-ylmethoxy, pyrrol-1-ylethoxy, 1-methyl-pyrrol-2-ylmethoxy, pyrrol-2-ylmethoxy, 1-Boc-pyrrol-2-ylmethoxy, 1-Boc-piperdin-4-ylmethoxy, piperdin-4-ylmethoxy, and 1-methylpiperdin-4-yloxy,

particularly when R<sup>2</sup> is phenyl, it has a substituent selected from optionally substituted 4-6 membered heterocyclyl-C<sub>1</sub>-C<sub>4</sub>-alkyl, optionally substituted 4-6 membered heterocyclyl-C<sub>2</sub>-C<sub>4</sub>-alkenyl, optionally substituted 4-6 membered heterocyclyl, optionally substituted 4-6 membered heterocyclyloxy, optionally substituted 4-6 membered heterocyclyl-C<sub>1</sub>-C<sub>4</sub>-alkoxy, optionally substituted 4-6 membered heterocyclylsulfonyl, optionally substituted 4-6 membered heterocyclylamino, optionally substituted 4-6 membered heterocyclylcarbonyl, optionally substituted 4-6 membered heterocyclylcarbonyl-C<sub>1-4</sub>-alkyl, optionally substituted 4-6 membered heterocyclyl-C<sub>1-4</sub>-alkylcarbonyl;

wherein R<sup>7</sup> is selected from H, C<sub>1-3</sub>-alkyl, optionally substituted phenyl-C<sub>1-3</sub>-alkyl, 4-6 membered heterocyclyl, and optionally substituted 4-6 membered heterocyclyl-C<sub>1-3</sub>-alkyl;

- 5 wherein R<sup>e</sup> and R<sup>f</sup> are independently selected from H and C<sub>1-2</sub>-haloalkyl, preferably -CF<sub>3</sub>;

- wherein R<sup>g</sup> is selected from H, C<sub>1-3</sub>-alkyl, optionally substituted phenyl-C<sub>1-3</sub>-alkyl, 4-6 membered heterocyclyl, and optionally substituted 4-6 membered heterocyclyl-C<sub>1-3</sub>-alkyl, C<sub>1-3</sub>-alkoxy-C<sub>1-2</sub>-alkyl and C<sub>1-3</sub>-alkoxy-C<sub>1-3</sub>-alkoxy-C<sub>1-3</sub>-alkyl; and
- 10

- where R<sup>h</sup> is one or more substituents selected from H, halo, amino, hydroxy, C<sub>1-6</sub>-alkyl, C<sub>1-6</sub>-haloalkyl, C<sub>1-6</sub>-alkoxy, C<sub>1-6</sub>-haloalkoxy, C<sub>1-6</sub>-aminoalkyl, C<sub>1-6</sub>-hydroxyalkyl, optionally substituted phenyl, optionally substituted heterocyclyl, optionally substituted heterocyclyl-C<sub>1-6</sub>-alkoxy, aminosulfonyl, C<sub>3-6</sub>-cycloalkyl, C<sub>1-6</sub>-alkylamino, C<sub>1-6</sub>-alkylamino-C<sub>1-6</sub>-alkyl, optionally substituted heterocyclyl-C<sub>1-6</sub>-alkylamino, optionally substituted heterocyclyl-C<sub>1-6</sub>-alkyl, C<sub>1-6</sub>-alkylamino-C<sub>2-4</sub>-alkynyl, C<sub>1-6</sub>-alkylamino-C<sub>1-6</sub>-alkoxy, C<sub>1-6</sub>-alkylamino-C<sub>1-6</sub>-alkoxy-C<sub>1-6</sub>-alkoxy, and optionally substituted heterocyclyl-C<sub>2-4</sub>-alkynyl,
- 15
- 20

- 25 preferably H, chloro, fluoro, bromo, hydroxy, methoxy, ethoxy, -O-CH<sub>2</sub>-O-, trifluoromethoxy, 1-methylpiperidinylmethoxy, dimethylaminoethoxy, amino, dimethylamino, dimethylaminopropyl, diethylamino, aminosulfonyl, cyclohexyl,
- 30 dimethylaminopropynyl, 3-(4-morpholinyl)propyn-1-yl, dimethylaminoethoxyethoxy, 3-(4-morpholinyl)propylamino, optionally substituted piperidinyl, morpholinyl, optionally substituted piperazinyl, optionally substituted phenyl, methyl,

ethyl, propyl, cyano, hydroxymethyl, aminomethyl  
and trifluoromethyl,  
more preferably H, chloro, fluoro, bromo, cyano,  
methoxy, -O-CH<sub>2</sub>-O-, amino, trifluoromethyl,  
5 trifluoromethoxy, 3-(4-morpholinyl)propyn-1-yl,  
dimethylaminopropyl, and 3-(4-  
morpholinyl)propylamino,  
particularly 4-fluoro;  
provided R<sup>2</sup> is not 3-trifluoromethylphenyl when R<sup>1</sup> is H and  
10 R<sup>8</sup> is 4-hydroxy, 3-hydroxy or H; and further provided R<sup>2</sup>  
is not 2-methoxyphenyl when R<sup>1</sup> is H and R<sup>8</sup> is H.

A family of specific compounds of particular interest  
within Formula I consists of compounds and pharmaceutically-  
15 acceptable derivatives thereof as follows:  
2-(3-Fluoro-benzylamino)-N-(4-phenoxy-phenyl)-nicotinamide;  
2-(3-Fluoro-benzylamino)-N-(4-phenoxy-phenyl)-nicotinamide,  
trifluoroacetate salt;  
N-[4-tert-Butyl-3-(pyrrolidin-2-ylmethoxy)-phenyl]-2-(4-  
20 fluoro-benzylamino)-nicotinamide, hydrochloride salt;  
N-(4-Phenoxy-phenyl)-2-(3-trifluoromethyl-benzylamino)-  
nicotinamide;  
2-(4-Fluoro-benzylamino)-N-(4-phenoxy-phenyl)-nicotinamide;  
N-(4-Phenoxy-phenyl)-2-(4-trifluoromethyl-benzylamino)-  
25 nicotinamide;  
2-(2-Bromo-benzylamino)-N-(4-phenoxy-phenyl)-nicotinamide;  
N-(4-Phenoxy-phenyl)-2-(4-trifluoromethoxy-benzylamino)-  
nicotinamide;  
2-(2,3-Difluoro-benzylamino)-N-(4-phenoxy-phenyl)-  
30 nicotinamide;  
N-(4-Chlorophenyl)(2-{{(4-cyanophenyl)methyl}amino}(3-  
pyridyl))carboxamide;  
N-(4-Chlorophenyl)(2-{{(2-cyanophenyl)methyl}amino}(3-  
pyridyl))carboxamide;

- N-(4-sec-butylphenyl)-2-[(4-fluorobenzyl)amino]nicotinamide;  
N-(4-tert-Butylphenyl)-2-[(4-fluorobenzyl)amino]nicotinamide;  
N-(4-Isopropyl-phenyl)-2-(3-methoxy-benzylamino)-  
5     nicotinamide;  
(2-[[ (3-Aminophenyl)methyl]amino] (3-pyridyl))-N-[4-(methylethyl)phenyl]carboxamide;  
(2-[[ (4-Fluorophenyl)methyl]amino] (3-pyridyl))-N-[4-(methylethyl)phenyl]carboxamide;  
10   (2-[[ (4-Fluorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-[[ (3,4-Dimethoxyphenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-[Benzylamino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]-carboxamide;  
15   (2-[[ (3-Chlorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-[[ (4-Bromophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
20   (2-[[ (4-Chlorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-[[ (2,4-Difluorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-[[ (4-Fluorophenyl)ethyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
25   (2-[[ (3,4-Difluorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-[[ (2,3-Difluorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
30   (2-[[ (2-Fluorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-[[ (2,6-Difluorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;

20250405 10:45:55

- (2-{{{(3-Bromophenyl)methyl}amino}(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide;  
(2-{{{(4-Fluorophenyl)methyl}amino}(3-pyridyl))-N-[4-(trifluoromethyl)phenyl]carboxamide;  
5 N-{3-[3-(Dimethylamino)propyl]-5-(trifluoromethyl)phenyl}(2-{{{(4-fluorophenyl)methyl}amino}(3-pyridyl))carboxamide;  
(2-{{{(3-[3-(Dimethylamino)propyl]-4-fluorophenyl)methyl}amino}(3-pyridyl))-N-[4-(tert-butyl)phenyl]carboxamide;  
10 (2-{{{(3-[3-(Dimethylamino)propyl]-4-fluorophenyl)methyl}amino}(3-pyridyl))-N-[4-(trifluoromethyl)phenyl]carboxamide;  
(2-{{{(3-[3-(Dimethylamino)propyl]-4-fluorophenyl)methyl}amino}(3-pyridyl))-N-(4-bromo-2-  
15 fluorophenyl)carboxamide;  
2-[4-Fluorobenzyl]amino]-N-[4-tert-butyl-3-(1,2,3,6-tetrahydropyridin-4-yl)phenyl]nicotinamide; and  
(2-{{{[4-Fluoro-3-(3-morpholin-4-ylprop-1-ynyl)phenyl]methyl}amino}(3-pyridyl))-N-[3-  
20 (trifluoromethyl)phenyl]carboxamide.

### Indications

Compounds of the present invention would be useful for, but not limited to, the prevention or treatment of  
25 angiogenesis-related diseases. The compounds of the invention have kinase inhibitory activity, such as VEGFR/KDR inhibitory activity. The compounds of the invention are useful in therapy as antineoplasia agents or to minimize deleterious effects of VEGF.

30 Compounds of the invention would be useful for the treatment of neoplasia including cancer and metastasis, including, but not limited to: carcinoma such as cancer of the bladder, breast, colon, kidney, liver, lung (including small cell lung cancer), esophagus, gall-bladder, ovary,  
35 pancreas, stomach, cervix, thyroid, prostate, and skin



(including squamous cell carcinoma); hematopoietic tumors of lymphoid lineage (including leukemia, acute lymphocytic leukemia, acute lymphoblastic leukemia, B-cell lymphoma, T-cell-lymphoma, Hodgkin's lymphoma, non-Hodgkin's lymphoma, hairy cell lymphoma and Burkett's lymphoma); hematopoietic tumors of myeloid lineage (including acute and chronic myelogenous leukemias, myelodysplastic syndrome and promyelocytic leukemia); tumors of mesenchymal origin (including fibrosarcoma and rhabdomyosarcoma, and other sarcomas, e.g. soft tissue and bone); tumors of the central and peripheral nervous system (including astrocytoma, neuroblastoma, glioma and schwannomas); and other tumors (including melanoma, seminoma, teratocarcinoma, osteosarcoma, xenoderma pigmentosum, keratocanthoma, thyroid follicular cancer and Kaposi's sarcoma).

Preferably, the compounds are useful for the treatment of neoplasia selected from lung cancer, colon cancer and breast cancer.

The compounds also would be useful for treatment of ophthalmological conditions such as corneal graft rejection, ocular neovascularization, retinal neovascularization including neovascularization following injury or infection, diabetic retinopathy, retrolental fibroplasia and neovascular glaucoma; retinal ischemia; vitreous hemorrhage; ulcerative diseases such as gastric ulcer; pathological, but non-malignant, conditions such as hemangiomas, including infantile hemangiomas, angiofibroma of the nasopharynx and avascular necrosis of bone; and disorders of the female reproductive system such as endometriosis. The compounds are also useful for the treatment of edema, and conditions of vascular hyperpermeability.

The compounds of the invention are useful in therapy of proliferative diseases. These compounds can be used for the treatment of an inflammatory rheumatoid or rheumatic

disease, especially of manifestations at the locomotor apparatus, such as various inflammatory rheumatoid diseases, especially chronic polyarthritis including rheumatoid arthritis, juvenile arthritis or psoriasis arthropathy;

5 paraneoplastic syndrome or tumor-induced inflammatory diseases, turbid effusions, collagenosis, such as systemic Lupus erythematosus, poly-myositis, dermato-myositis, systemic sclerodermia or mixed collagenosis; postinfectious arthritis (where no living pathogenic organism can be found

10 at or in the affected part of the body), seronegative spondylarthritis, such as spondylitis ankylosans; vasculitis, sarcoidosis, or arthrosis; or further any combinations thereof. An example of an inflammation related disorder is (a) synovial inflammation, for example,

15 synovitis, including any of the particular forms of synovitis, in particular bursal synovitis and purulent synovitis, as far as it is not crystal-induced. Such synovial inflammation may for example, be consequential to or associated with disease, e.g. arthritis, e.g.

20 osteoarthritis, rheumatoid arthritis or arthritis deformans. The present invention is further applicable to the systemic treatment of inflammation, e.g. inflammatory diseases or conditions, of the joints or locomotor apparatus in the region of the tendon insertions and tendon sheaths. Such

25 inflammation may be, for example, be consequential to or associated with disease or further (in a broader sense of the invention) with surgical intervention, including, in particular conditions such as insertion endopathy, myofasciale syndrome and tendomyosis. The present invention

30 is further especially applicable to the treatment of inflammation, e.g. inflammatory disease or condition, of connective tissues including dermatomyositis and myositis.

These compounds can be used as active agents against such disease states as arthritis, atherosclerosis,

psoriasis, hemangiomas, myocardial angiogenesis, coronary and cerebral collaterals, ischemic limb angiogenesis, wound healing, peptic ulcer Helicobacter related diseases, fractures, cat scratch fever, rubeosis, neovascular glaucoma and retinopathies such as those associated with diabetic retinopathy or macular degeneration. In addition, some of these compounds can be used as active agents against solid tumors, malignant ascites, hematopoietic cancers and hyperproliferative disorders such as thyroid hyperplasia (especially Grave's disease), and cysts (such as hypervascularity of ovarian stroma, characteristic of polycystic ovarian syndrome (Stein- Leventhal syndrome)) since such diseases require a proliferation of blood vessel cells for growth and/or metastasis.

Further, some of these compounds can be used as active agents against burns, chronic lung disease, stroke, polyps, anaphylaxis, chronic and allergic inflammation, ovarian hyperstimulation syndrome, brain tumor-associated cerebral edema, high-altitude, trauma or hypoxia induced cerebral or pulmonary edema, ocular and macular edema, ascites, and other diseases where vascular hyperpermeability, effusions, exudates, protein extravasation, or edema is a manifestation of the disease. The compounds will also be useful in treating disorders in which protein extravasation leads to the deposition of fibrin and extracellular matrix, promoting stromal proliferation (e.g. fibrosis, cirrhosis and carpal tunnel syndrome).

The compounds of the present invention are also useful in the treatment of ulcers including bacterial, fungal, Mooren ulcers and ulcerative colitis.

The compounds of the present invention are also useful in the treatment of conditions wherein undesired angiogenesis, edema, or stromal deposition occurs in viral infections such as Herpes simplex, Herpes Zoster, AIDS,

Kaposi's sarcoma, protozoan infections and toxoplasmosis, following trauma, radiation, stroke, endometriosis, ovarian hyperstimulation syndrome, systemic lupus, sarcoidosis, synovitis, Crohn's disease, sickle cell anaemia, Lyme  
5 disease, pemphigoid, Paget's disease, hyperviscosity syndrome, Osler-Weber-Rendu disease, chronic inflammation, chronic occlusive pulmonary disease, asthma, and inflammatory rheumatoid or rheumatic disease. The compounds are also useful in the reduction of sub-cutaneous fat and  
10 for the treatment of obesity.

The compounds of the present invention are also useful in the treatment of ocular conditions such as ocular and macular edema, glaucoma, ocular neovascular disease, scleritis, radial keratotomy, uveitis, vitritis, myopia,  
15 optic pits, chronic retinal detachment, post-laser complications, conjunctivitis, Stargardt's disease and Eales disease in addition to retinopathy and macular degeneration.

The compounds of the present invention are also useful in the treatment of cardiovascular conditions such as  
20 atherosclerosis, restenosis, arteriosclerosis, vascular occlusion and carotid obstructive disease.

The compounds of the present invention are also useful in the treatment of cancer related indications such as solid tumors, sarcomas (especially Ewing's sarcoma and  
25 osteosarcoma), retinoblastoma, rhabdomyosarcomas, neuroblastoma, hematopoietic malignancies, including leukemia and lymphoma, tumor- induced pleural or pericardial effusions, and malignant ascites.

The compounds of the present invention are also useful  
30 in the treatment of diabetic conditions such as diabetic retinopathy and microangiopathy.

The compounds of this invention may also act as inhibitors of other protein kinases, e.g. p38, EGFR, CDK-2,

20140929001

CDK-5, IKK, JNK3, and thus be effective in the treatment of diseases associated with other protein kinases.

Besides being useful for human treatment, these compounds are also useful for veterinary treatment of  
5 companion animals, exotic animals and farm animals, including mammals, rodents, and the like. More preferred animals include horses, dogs, and cats.

As used herein, the compounds of the present invention include the pharmaceutically acceptable derivatives  
10 thereof.

### Definitions

A "pharmaceutically-acceptable derivative" denotes any salt, ester of a compound of this invention, or any other  
15 compound which upon administration to a patient is capable of providing (directly or indirectly) a compound of this invention, or a metabolite or residue thereof, characterized by the ability to inhibit angiogenesis.

The term "treatment" includes therapeutic treatment as  
20 well as prophylactic treatment (either preventing the onset of disorders altogether or delaying the onset of a preclinically evident stage of disorders in individuals).

The phrase "therapeutically-effective" is intended to qualify the amount of each agent, which will achieve the  
25 goal of improvement in disorder severity and the frequency of incidence over treatment of each agent by itself, while avoiding adverse side effects typically associated with alternative therapies. For example, effective neoplastic therapeutic agents prolong the survivability of the patient,  
30 inhibit the rapidly-proliferating cell growth associated with the neoplasm, or effect a regression of the neoplasm.

The term "prevention" includes either preventing the onset of disorders altogether or delaying the onset of a preclinically evident stage of disorders in individuals.

This includes prophylactic treatment of those at risk of developing a disease, such as a cancer, for example.

"Prophylaxis" is another term for prevention.

The term "H" denotes a single hydrogen atom. This  
5 radical may be attached, for example, to an oxygen atom to form a hydroxyl radical.

Where the term "alkyl" is used, either alone or within other terms such as "haloalkyl" and "alkylamino", it embraces linear or branched radicals having one to about  
10 twelve carbon atoms. More preferred alkyl radicals are "lower alkyl" radicals having one to about six carbon atoms. Examples of such radicals include methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, pentyl, isoamyl, hexyl and the like. Even more preferred are lower  
15 alkyl radicals having one or two carbon atoms. The term "alkylenyl" embraces bridging divalent alkyl radicals such as methylenyl and ethylenyl. The term "lower alkyl substituted with R<sup>1</sup>" does not include an acetal moiety.

The term "alkenyl" embraces linear or branched  
20 radicals having at least one carbon-carbon double bond of two to about twelve carbon atoms. More preferred alkenyl radicals are "lower alkenyl" radicals having two to about six carbon atoms. Most preferred lower alkenyl radicals are radicals having two to about four carbon atoms. Examples of  
25 alkenyl radicals include ethenyl, propenyl, allyl, propenyl, butenyl and 4-methylbutenyl. The terms "alkenyl" and "lower alkenyl", embrace radicals having "cis" and "trans" orientations, or alternatively, "E" and "Z" orientations.

The term "alkynyl" denotes linear or branched radicals  
30 having at least one carbon-carbon triple bond and having two to about twelve carbon atoms. More preferred alkynyl radicals are "lower alkynyl" radicals having two to about six carbon atoms. Most preferred are lower alkynyl radicals

having two to about four carbon atoms. Examples of such radicals include propargyl, butynyl, and the like.

The term "halo" means halogens such as fluorine, chlorine, bromine or iodine atoms.

5       The term "haloalkyl" embraces radicals wherein any one or more of the alkyl carbon atoms is substituted with halo as defined above. Specifically embraced are monohaloalkyl, dihaloalkyl and polyhaloalkyl radicals including perhaloalkyl. A monohaloalkyl radical, for one example, may  
10 have either an iodo, bromo, chloro or fluoro atom within the radical. Dihalo and polyhaloalkyl radicals may have two or more of the same halo atoms or a combination of different halo radicals. "Lower haloalkyl" embraces radicals having 1-6 carbon atoms. Even more preferred are lower haloalkyl  
15 radicals having one to three carbon atoms. Examples of haloalkyl radicals include fluoromethyl, difluoromethyl, trifluoromethyl, chloromethyl, dichloromethyl, trichloromethyl, pentafluoroethyl, heptafluoropropyl, difluorochloromethyl, dichlorofluoromethyl, difluoroethyl,  
20 difluoropropyl, dichloroethyl and dichloropropyl. "Perfluoroalkyl" means alkyl radicals having all hydrogen atoms replaced with fluoro atoms. Examples include trifluoromethyl and pentafluoroethyl.

25       The term "hydroxyalkyl" embraces linear or branched alkyl radicals having one to about ten carbon atoms any one of which may be substituted with one or more hydroxyl radicals. More preferred hydroxyalkyl radicals are "lower hydroxyalkyl" radicals having one to six carbon atoms and one or more hydroxyl radicals. Examples of such radicals  
30 include hydroxymethyl, hydroxyethyl, hydroxypropyl, hydroxybutyl and hydroxyhexyl. Even more preferred are lower hydroxyalkyl radicals having one to three carbon atoms.

The term "alkoxy" embrace linear or branched oxy-containing radicals each having alkyl portions of one to

about ten carbon atoms. More preferred alkoxy radicals are "lower alkoxy" radicals having one to six carbon atoms. Examples of such radicals include methoxy, ethoxy, propoxy, butoxy and *tert*-butoxy. Even more preferred are lower alkoxy radicals having one to three carbon atoms. Alkoxy radicals may be further substituted with one or more halo atoms, such as fluoro, chloro or bromo, to provide "haloalkoxy" radicals. Even more preferred are lower haloalkoxy radicals having one to three carbon atoms. Examples of such radicals include fluoromethoxy, chloromethoxy, trifluoromethoxy, trifluoroethoxy, fluoroethoxy and fluoropropoxy.

The term "aryl", alone or in combination, means a carbocyclic aromatic system containing one or two rings wherein such rings may be attached together in a fused manner. The term "aryl" embraces aromatic radicals such as phenyl, naphthyl, indenyl, tetrahydronaphthyl, and indanyl. More preferred aryl is phenyl. Said "aryl" group may have 1 to 3 substituents such as lower alkyl, hydroxyl, halo, haloalkyl, nitro, cyano, alkoxy and lower alkylamino. Phenyl substituted with -O-CH<sub>2</sub>-O- forms the aryl benzodioxolyl substituent.

The term "heterocyclyl" embraces saturated, partially saturated and unsaturated heteroatom-containing ring radicals, where the heteroatoms may be selected from nitrogen, sulfur and oxygen. It does not include rings containing -O-O-, -O-S- or -S-S- portions. Said "heterocyclyl" group may have 1 to 3 substituents such as hydroxyl, Boc, halo, haloalkyl, cyano, lower alkyl, lower aralkyl, oxo, lower alkoxy, amino and lower alkylamino.

Examples of saturated heterocyclic radicals include saturated 3 to 6-membered heteromonocyclic groups containing 1 to 4 nitrogen atoms [e.g. pyrrolidinyl, imidazolidinyl, piperidinyl, pyrrolinyl, piperazinyl]; saturated 3 to 6-membered heteromonocyclic group containing 1 to 2 oxygen



atoms and 1 to 3 nitrogen atoms [e.g. morpholinyl];  
saturated 3 to 6-membered heteromonocyclic group containing  
1 to 2 sulfur atoms and 1 to 3 nitrogen atoms [e.g.,  
thiazolidinyl]. Examples of partially saturated heterocycl  
5 radicals include dihydrothienyl, dihydropyranyl,  
dihydrofuryl and dihydrothiazolyl.

Examples of unsaturated heterocyclic radicals, also  
termed "heteroaryl" radicals, include unsaturated 5 to 6  
membered heteromonocyclyl group containing 1 to 4 nitrogen  
10 atoms, for example, pyrrolyl, imidazolyl, pyrazolyl, 2-  
pyridyl, 3-pyridyl, 4-pyridyl, pyrimidyl, pyrazinyl,  
pyridazinyl, triazolyl [e.g., 4H-1,2,4-triazolyl, 1H-1,2,3-  
triazolyl, 2H-1,2,3-triazolyl]; unsaturated 5- to 6-membered  
heteromonocyclic group containing an oxygen atom, for  
15 example, pyranlyl, 2-furyl, 3-furyl, etc.; unsaturated 5 to  
6-membered heteromonocyclic group containing a sulfur atom,  
for example, 2-thienyl, 3-thienyl, etc.; unsaturated 5- to  
6-membered heteromonocyclic group containing 1 to 2 oxygen  
atoms and 1 to 3 nitrogen atoms, for example, oxazolyl,  
20 isoxazolyl, oxadiazolyl [e.g., 1,2,4-oxadiazolyl, 1,3,4-  
oxadiazolyl, 1,2,5-oxadiazolyl]; unsaturated 5 to 6-membered  
heteromonocyclic group containing 1 to 2 sulfur atoms and 1  
to 3 nitrogen atoms, for example, thiazolyl, thiadiazolyl  
[e.g., 1,2,4-thiadiazolyl, 1,3,4-thiadiazolyl, 1,2,5-  
25 thiadiazolyl].

The term also embraces radicals where heterocyclic  
radicals are fused/condensed with aryl radicals:  
unsaturated condensed heterocyclic group containing 1 to 5  
nitrogen atoms, for example, indolyl, isoindolyl,  
30 indolizinyll, benzimidazolyl, quinolyl, isoquinolyl,  
indazolyl, benzotriazolyl, tetrazolopyridazinyl [e.g.,  
tetrazolo [1,5-b]pyridazinyl]; unsaturated condensed  
heterocyclic group containing 1 to 2 oxygen atoms and 1 to 3  
nitrogen atoms [e.g. benzoxazolyl, benzoxadiazolyl];

unsaturated condensed heterocyclic group containing 1 to 2 sulfur atoms and 1 to 3 nitrogen atoms [e.g., benzothiazolyl, benzothiadiaazolyl]; and saturated, partially unsaturated and unsaturated condensed heterocyclic group  
5 containing 1 to 2 oxygen or sulfur atoms [e.g. benzofuryl, benzothienyl, 2,3-dihydro-benzo[1,4]dioxinyl and dihydrobenzofuryl]. Preferred heterocyclic radicals include five to ten membered fused or unfused radicals. More preferred examples of heteroaryl radicals include quinolyl,  
10 isoquinolyl, imidazolyl, pyridyl, thienyl, thiazolyl, oxazolyl, furyl, and pyrazinyl. Other preferred heteroaryl radicals are 5- or 6-membered heteroaryl, containing one or two heteroatoms selected from sulfur, nitrogen and oxygen, selected from thienyl, furyl, pyrrolyl, indazolyl,  
15 pyrazolyl, oxazolyl, triazolyl, imidazolyl, pyrazolyl, isoxazolyl, isothiazolyl, pyridyl, piperidinyl and pyrazinyl.

Particular examples of non-nitrogen containing heteroaryl include pyranyl, 2-furyl, 3-furyl, 2-thienyl, 3-  
20 thienyl, benzofuryl, benzothienyl, and the like.

Particular examples of partially saturated and saturated heterocyclyl include pyrrolidinyl, imidazolidinyl, piperidinyl, pyrrolinyl, pyrazolidinyl, piperazinyl, morpholinyl, tetrahydropyranyl, thiazolidinyl,  
25 dihydrothienyl, 2,3-dihydro-benzo[1,4]dioxanyl, indolinyl, isoindolinyl, dihydrobenzothienyl, dihydrobenzofuryl, isochromanlyl, chromanlyl, 1,2-dihydroquinolyl, 1,2,3,4-tetrahydro-isoquinolyl, 1,2,3,4-tetrahydro-quinolyl, 2,3,4,4a,9,9a-hexahydro-1H-3-aza-fluorenyl, 5,6,7-trihydro-  
30 1,2,4-triazolo[3,4-a]isoquinolyl, 3,4-dihydro-2H-benzo[1,4]oxazinyl, benzo[1,4]dioxanyl, 2,3-dihydro-1H-1λ'-benzo[d]isothiazol-6-yl, dihydropyranyl, dihydrofuryl and dihydrothiazolyl, and the like.

The term "sulfonyl", whether used alone or linked to other terms such as alkylsulfonyl, denotes respectively divalent radicals  $-\text{SO}_2-$ .

The terms "sulfamyl," "aminosulfonyl" and  
5 "sulfonamidyl," denotes a sulfonyl radical substituted with an amine radical, forming a sulfonamide ( $-\text{SO}_2\text{NH}_2$ ).

The term "alkylaminosulfonyl" includes "N-alkylaminosulfonyl" where sulfamyl radicals are independently substituted with one or two alkyl radical(s).  
10 More preferred alkylaminosulfonyl radicals are "lower alkylaminosulfonyl" radicals having one to six carbon atoms. Even more preferred are lower alkylaminosulfonyl radicals having one to three carbon atoms. Examples of such lower alkylaminosulfonyl radicals include N-methylaminosulfonyl,  
15 and N-ethylaminosulfonyl.

The terms "carboxy" or "carboxyl", whether used alone or with other terms, such as "carboxyalkyl", denotes  $-\text{CO}_2\text{H}$ .

The term "carbonyl", whether used alone or with other terms, such as "aminocarbonyl", denotes  $-(\text{C}=\text{O})-$ .

20 The term "aminocarbonyl" denotes an amide group of the formula  $-\text{C}(=\text{O})\text{NH}_2$ .

The terms "N-alkylaminocarbonyl" and "N,N-dialkylaminocarbonyl" denote aminocarbonyl radicals independently substituted with one or two alkyl radicals,  
25 respectively. More preferred are "lower alkylaminocarbonyl" having lower alkyl radicals as described above attached to an aminocarbonyl radical.

The terms "N-arylaminocarbonyl" and "N-alkyl-N-arylaminocarbonyl" denote aminocarbonyl radicals  
30 substituted, respectively, with one aryl radical, or one alkyl and one aryl radical.

The term "heterocyclylcarbonylalkyl" denotes alkyl groups which have been substituted with a heterocyclylcarbonyl radical. More preferred are contain 4-6

membered heterocyclyl groups and C<sub>1</sub>-C<sub>6</sub>-alkyl radicals, such as 4-methylpiperazinylcarbonylethyl.

The term "heterocyclylalkylcarbonyl" denotes carbonyl groups which have been substituted with a heterocyclylalkyl radical. More preferred are contain 4-6 membered heterocyclyl groups and C<sub>1</sub>-C<sub>6</sub>-alkyl radicals, such as piperidinylmethylcarbonyl.

The term "alkoxycarbonylaminoalkyl" denotes an aminoalkyl group, which is substituted with an alkoxycarbonyl radical. More preferred are "lower alkoxycarbonylaminoalkyl" having C<sub>1</sub>-C<sub>6</sub>-alkyl radicals.

The term "heterocyclylalkylenyl" embraces heterocyclic-substituted alkyl radicals. More preferred heterocyclylalkylenyl radicals are "5- or 6-membered heteroarylalkylenyl" radicals having alkyl portions of one to six carbon atoms and a 5- or 6-membered heteroaryl radical. Even more preferred are lower heteroarylalkylenyl radicals having alkyl portions of one to four carbon atoms. Examples include such radicals as pyridylmethyl and thienylmethyl.

The term "aralkyl" embraces aryl-substituted alkyl radicals. Preferable aralkyl radicals are "lower aralkyl" radicals having aryl radicals attached to alkyl radicals having one to six carbon atoms. Even more preferred are "phenylalkylenyl" attached to alkyl portions having one to three carbon atoms. Examples of such radicals include benzyl, diphenylmethyl and phenylethyl. The aryl in said aralkyl may be additionally substituted with halo, alkyl, alkoxy, haloalkyl and haloalkoxy.

The term "alkylthio" embraces radicals containing a linear or branched alkyl radical, of one to ten carbon atoms, attached to a divalent sulfur atom. Even more preferred are lower alkylthio radicals having one to three

carbon atoms. An example of "alkylthio" is methylthio, (CH<sub>3</sub>S-).

The term "haloalkylthio" embraces radicals containing a haloalkyl radical, of one to ten carbon atoms, attached to a divalent sulfur atom. Even more preferred are lower haloalkylthio radicals having one to three carbon atoms. An example of "haloalkylthio" is trifluoromethylthio.

The term "alkylamino" embraces "N-alkylamino" and "N,N-dialkylamino" where amino groups are independently substituted with one alkyl radical and with two alkyl radicals, respectively. More preferred alkylamino radicals are "lower alkylamino" radicals having one or two alkyl radicals of one to six carbon atoms, attached to a nitrogen atom. Even more preferred are lower alkylamino radicals having one to three carbon atoms. Suitable alkylamino radicals may be mono or dialkylamino such as N-methylamino, N-ethylamino, N,N-dimethylamino, N,N-diethylamino and the like.

The term "arylamino" denotes amino groups which have been substituted with one or two aryl radicals, such as N-phenylamino. The arylamino radicals may be further substituted on the aryl ring portion of the radical.

The term "heteroarylamino" denotes amino groups which have been substituted with one or two heteroaryl radicals, such as N-thienylamino. The "heteroarylamino" radicals may be further substituted on the heteroaryl ring portion of the radical.

The term "aralkylamino" denotes amino groups which have been independently substituted with one or two aralkyl radicals. More preferred are phenyl-C<sub>1</sub>-C<sub>3</sub>-alkylamino radicals, such as N-benzylamino. The aralkylamino radicals may be further substituted on the aryl ring portion.

The terms "N-alkyl-N-arylamino" and "N-aralkyl-N-alkylamino" denote amino groups which are independently

1004555-04002

substituted with one aralkyl and one alkyl radical, or one aryl and one alkyl radical, respectively, to an amino group.

The term "aminoalkyl" embraces linear or branched alkyl radicals having one to about ten carbon atoms any one of which may be substituted with one or more amino radicals. More preferred aminoalkyl radicals are "lower aminoalkyl" radicals having one to six carbon atoms and one or more amino radicals. Examples of such radicals include aminomethyl, aminoethyl, aminopropyl, aminobutyl and aminohexyl. Even more preferred are lower aminoalkyl radicals having one to three carbon atoms.

The term "alkylaminoalkyl" embraces alkyl radicals substituted with alkylamino radicals. More preferred alkylaminoalkyl radicals are "lower alkylaminoalkyl" radicals having alkyl radicals of one to six carbon atoms. Even more preferred are lower alkylaminoalkyl radicals having alkyl radicals of one to three carbon atoms. Suitable alkylaminoalkyl radicals may be mono or dialkyl substituted, such as N-methylaminomethyl, N,N-dimethyl-aminoethyl, N,N-diethylaminomethyl and the like.

The term "alkylaminoalkoxy" embraces alkoxy radicals substituted with alkylamino radicals. More preferred alkylaminoalkoxy radicals are "lower alkylaminoalkoxy" radicals having alkoxy radicals of one to six carbon atoms. Even more preferred are lower alkylaminoalkoxy radicals having alkyl radicals of one to three carbon atoms. Suitable alkylaminoalkoxy radicals may be mono or dialkyl substituted, such as N-methylaminoethoxy, N,N-dimethylaminoethoxy, N,N-diethylaminoethoxy and the like.

The term "alkylaminoalkoxyalkoxy" embraces alkoxy radicals substituted with alkylaminoalkoxy radicals. More preferred alkylaminoalkoxyalkoxy radicals are "lower alkylaminoalkoxyalkoxy" radicals having alkoxy radicals of one to six carbon atoms. Even more preferred are lower

alkylaminoalkoxyalkoxy radicals having alkyl radicals of one to three carbon atoms. Suitable alkylaminoalkoxyalkoxy radicals may be mono or dialkyl substituted, such as N-methylaminoethoxyethoxy, N-methylaminomethoxyethoxy, N,N-dimethylaminoethoxyethoxy, N,N-diethylaminomethoxymethoxy and the like.

The term "carboxyalkyl" embraces linear or branched alkyl radicals having one to about ten carbon atoms any one of which may be substituted with one or more carboxy radicals. More preferred carboxyalkyl radicals are "lower carboxyalkyl" radicals having one to six carbon atoms and one carboxy radical. Examples of such radicals include carboxymethyl, carboxypropyl, and the like. Even more preferred are lower carboxyalkyl radicals having one to three CH<sub>2</sub> groups.

The term "halosulfonyl" embraces sulfonyl radicals substituted with a halogen radical. Examples of such halosulfonyl radicals include chlorosulfonyl and fluorosulfonyl.

The term "arylthio" embraces aryl radicals of six to ten carbon atoms, attached to a divalent sulfur atom. An example of "arylthio" is phenylthio.

The term "aralkylthio" embraces aralkyl radicals as described above, attached to a divalent sulfur atom. More preferred are phenyl-C<sub>1</sub>-C<sub>3</sub>-alkylthio radicals. An example of "aralkylthio" is benzylthio.

The term "aryloxy" embraces optionally substituted aryl radicals, as defined above, attached to an oxygen atom. Examples of such radicals include phenoxy.

The term "aralkoxy" embraces oxy-containing aralkyl radicals attached through an oxygen atom to other radicals. More preferred aralkoxy radicals are "lower aralkoxy" radicals having optionally substituted phenyl radicals attached to lower alkoxy radical as described above.

The term "heteroaryloxy" embraces optionally substituted heteroaryl radicals, as defined above, attached to an oxygen atom.

5 The term "heteroarylalkoxy" embraces oxy-containing heteroarylalkyl radicals attached through an oxygen atom to other radicals. More preferred heteroarylalkoxy radicals are "lower heteroarylalkoxy" radicals having optionally substituted heteroaryl radicals attached to lower alkoxy radical as described above.

10 The term "cycloalkyl" includes saturated carbocyclic groups. Preferred cycloalkyl groups include C<sub>3</sub>-C<sub>6</sub> rings. More preferred compounds include, cyclopentyl, cyclopropyl, and cyclohexyl.

15 The term "cycloalkylalkyl" embraces cycloalkyl-substituted alkyl radicals. Preferable cycloalkylalkyl radicals are "lower cycloalkylalkyl" radicals having C<sub>3-6</sub> cycloalkyl radicals attached to alkyl radicals having one to six carbon atoms.

20 The term "cycloalkenyl" includes carbocyclic groups having one or more carbon-carbon double bonds including "cycloalkyldienyl" compounds. Preferred cycloalkenyl groups include C<sub>3</sub>-C<sub>6</sub> rings. More preferred compounds include, for example, cyclopentenyl, cyclopentadienyl, cyclohexenyl and cycloheptadienyl.

25 The term "comprising" is meant to be open ended, including the indicated component but not excluding other elements.

The term "Formulas I-III" includes formula II'.

30 The compounds of the invention are endowed with kinase inhibitory activity, such as KDR inhibitory activity.

The present invention also comprises the use of a compound of the invention, or pharmaceutically acceptable salt thereof, in the manufacture of a medicament for the treatment either acutely or chronically of an angiogenesis

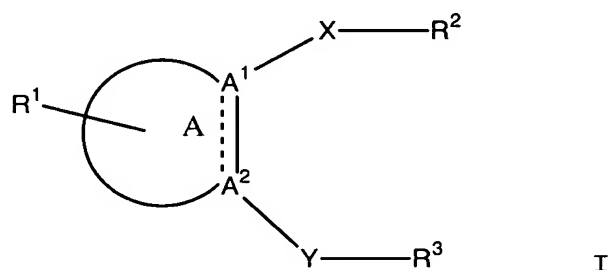
20190404 14:04:04



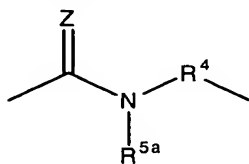
mediated disease state, including those described previously. The compounds of the present invention are useful in the manufacture of an anti-cancer medicament. The compounds of the present invention are also useful in the  
 5 manufacture of a medicament to attenuate or prevent disorders through inhibition of KDR.

The present invention comprises a pharmaceutical composition comprising a therapeutically-effective amount of a compound of Formulas I-III in association with a least one  
 10 pharmaceutically-acceptable carrier, adjuvant or diluent.

The present invention also comprises a method of treating angiogenesis related disorders in a subject having or susceptible to such disorder, the method comprising treating the subject with a therapeutically-effective amount  
 15 of a compound of Formula I

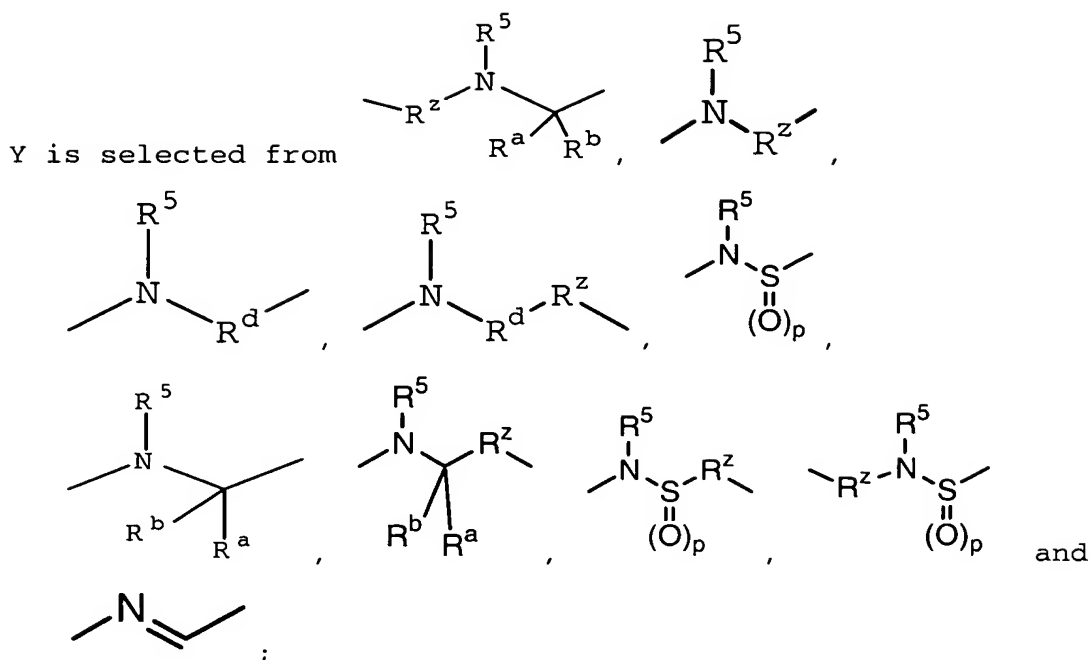


wherein each of A<sup>1</sup> and A<sup>2</sup> is independently C or N;  
 20 wherein A<sup>1</sup>-A<sup>2</sup> form part of a ring A selected from 5- or 6-membered heteroaryl;



wherein X is

wherein Z is oxygen or sulfur;



5

wherein p is 0 to 2,

wherein  $R^a$  and  $R^b$  are independently selected from H, halo, cyano,  $-NHR^6$  and  $C_{1-4}$ -alkyl substituted with  $R^1$ , or wherein  $R^a$  and  $R^b$  together form  $C_3$ - $C_6$  cycloalkyl;

10 wherein  $R^z$  is selected from  $C_2$ - $C_6$ -alkylenyl, where one of the  $CH_2$  groups may be replaced with an oxygen atom or an  $-NH-$ ; wherein one of the  $CH_2$  groups may be substituted with one or two radicals selected from halo, cyano,  $-NHR^6$  and  $C_{1-4}$ -alkyl substituted with  $R^1$ ;

15 wherein  $R^d$  is cycloalkyl;

wherein  $R^1$  is one or more substituents independently selected from H, halo,  $-OR^7$ , oxo,  $-SR^7$ ,  $-CO_2R^7$ ,  $-COR^7$ ,  $-CONR^7R^7$ ,  $-NR^7R^7$ ,  $-SO_2NR^7R^7$ ,  $-NR^7C(O)OR^7$ ,  $-NR^7C(O)R^7$ ,  $-NR^7C(O)NR^7R^7$ , cycloalkyl, optionally substituted

20 phenylalkylenyl, optionally substituted 5-6 membered heterocyclyl, optionally substituted heteroarylalkylenyl, optionally substituted phenyl, lower alkyl, cyano, lower hydroxyalkyl, lower carboxyalkyl, nitro, lower alkenyl,

lower alkynyl, lower aminoalkyl, lower alkylaminoalkyl  
and lower haloalkyl;

wherein  $R^2$  is selected from

- a) substituted or unsubstituted 6-10 membered aryl,
- 5 b) substituted or unsubstituted 5-6 membered heterocyclyl,
- c) substituted or unsubstituted 9-14 membered bicyclic or tricyclic heterocyclyl,
- d) cycloalkyl, and
- 10 e) cycloalkenyl,

wherein substituted  $R^2$  is substituted with one or more substituents independently selected from halo,  $-OR^7$ ,  $-SR^7$ ,  $-CO_2R^7$ ,  $-CONR^7R^7$ ,  $-COR^7$ ,  $-NR^7R^7$ ,  $-NH(C_1-C_4$   
alkylenyl $R^9)$ ,  $-SO_2R^7$ ,  $-SO_2NR^7R^7$ ,  $-NR^7C(O)OR^7$ ,  $-NR^7C(O)R^7$ ,  
15 optionally substituted cycloalkyl, optionally substituted 5-6 membered heterocyclyl, optionally substituted phenyl, halosulfonyl, cyano, alkylaminoalkoxy, alkylaminoalkoxyalkoxy, nitro, lower alkyl substituted with  $R^1$ , lower alkenyl substituted  
20 with  $R^1$ , and lower alkynyl substituted with  $R^1$ ;

wherein  $R^3$  is selected from aryl substituted with one or more substituents independently selected from halo,  $-OR^7$ ,  $-SR^7$ ,  $-SO_2R^7$ ,  $-CO_2R^7$ ,  $-CONR^7R^7$ ,  $-COR^7$ ,  $-NR^7R^7$ ,  $-SO_2NR^7R^7$ ,  $-NR^7C(O)OR^7$ ,  $-NR^7C(O)R^7$ , cycloalkyl, optionally substituted  
25 5-6 membered heterocyclyl, optionally substituted phenyl, nitro, alkylaminoalkoxyalkoxy, cyano, alkylaminoalkoxy, lower alkyl substituted with  $R^1$ , lower alkenyl substituted with  $R^1$ , and lower alkynyl substituted with  $R^1$ ;

30 wherein  $R^4$  is selected from a direct bond,  $C_{2-4}$ -alkylenyl,  $C_{2-4}$ -alkenylenyl and  $C_{2-4}$ -alkynylenyl, where one of the  $CH_2$  groups may be substituted with an oxygen atom or an  $-NH-$ , wherein  $R^4$  is optionally substituted with hydroxy;

wherein R<sup>5</sup> is selected from H, lower alkyl, phenyl and lower aralkyl;

wherein R<sup>5a</sup> is selected from H, lower alkyl, phenyl and lower aralkyl;

5 wherein R<sup>6</sup> is selected from H or C<sub>1-6</sub>-alkyl; and

wherein R<sup>7</sup> is selected from H, lower alkyl, phenyl, 5-6 membered heterocyclyl, C<sub>3</sub>-C<sub>6</sub>-cycloalkyl, phenylalkyl, 5-6 membered heterocyclylalkyl, C<sub>3</sub>-C<sub>6</sub> cycloalkylalkyl, and lower haloalkyl;

10 wherein R<sup>9</sup> is selected from H, phenyl, 5-6 membered heterocyclyl and C<sub>3</sub>-C<sub>6</sub> cycloalkyl.

#### COMBINATIONS

15 While the compounds of the invention can be administered as the sole active pharmaceutical agent, they can also be used in combination with one or more compounds of the invention or other agents. When administered as a combination, the therapeutic agents can be formulated as  
20 separate compositions that are administered at the same time or sequentially at different times, or the therapeutic agents can be given as a single composition.

The phrase "co-therapy" (or "combination-therapy"), in defining use of a compound of the present invention and  
25 another pharmaceutical agent, is intended to embrace administration of each agent in a sequential manner in a regimen that will provide beneficial effects of the drug combination, and is intended as well to embrace co-administration of these agents in a substantially  
30 simultaneous manner, such as in a single capsule having a fixed ratio of these active agents or in multiple, separate capsules for each agent.

Specifically, the administration of compounds of the present invention may be in conjunction with additional  
35 therapies known to those skilled in the art in the

prevention or treatment of neoplasia, such as with radiation therapy or with cytostatic or cytotoxic agents.

If formulated as a fixed dose, such combination products employ the compounds of this invention within the  
5 accepted dosage ranges. Compounds of Formulas I-III may also be administered sequentially with known anticancer or cytotoxic agents when a combination formulation is inappropriate. The invention is not limited in the sequence of administration; compounds of the invention may be  
10 administered either prior to, simultaneous with, or after administration of the known anticancer or cytotoxic agent.

Currently, standard treatment of primary tumors consists of surgical excision followed by either radiation or IV administered chemotherapy. The typical chemotherapy  
15 regime consists of either DNA alkylating agents, DNA intercalating agents, CDK inhibitors, or microtubule poisons. The chemotherapy doses used are just below the maximal tolerated dose and therefore dose limiting toxicities typically include, nausea, vomiting, diarrhea,  
20 hair loss, neutropenia and the like.

There are large numbers of antineoplastic agents available in commercial use, in clinical evaluation and in pre-clinical development, which would be selected for treatment of neoplasia by combination drug chemotherapy.  
25 Such antineoplastic agents fall into several major categories, namely, antibiotic-type agents, alkylating agents, antimetabolite agents, hormonal agents, immunological agents, interferon-type agents and a category of miscellaneous agents.

30 A first family of antineoplastic agents which may be used in combination with compounds of the present invention consists of antimetabolite-type/thymidilate synthase inhibitor antineoplastic agents. Suitable antimetabolite antineoplastic agents may be selected from but not limited

20250101 09:29:00

to the group consisting of 5-FU-fibrinogen, acanthifolic acid, aminothiadiaazole, brequinar sodium, carmofur, Ciba-Geigy CGP-30694, cyclopentyl cytosine, cytarabine phosphate stearate, cytarabine conjugates, Lilly DATHF, Merrel Dow

5 DDFC, dezaguanine, dideoxycytidine, dideoxyguanosine, didox, Yoshitomi DMDC, doxifluridine, Wellcome EHNA, Merck & Co. EX-015, fazarabine, floxuridine, fludarabine phosphate, 5-fluorouracil, N-(2'-furanidyl)-5-fluorouracil, Daiichi Seiyaku FO-152, isopropyl pyrrolizine, Lilly LY-188011,

10 Lilly LY-264618, methobenzaprim, methotrexate, Wellcome MZPES, norspermidine, NCI NSC-127716, NCI NSC-264880, NCI NSC-39661, NCI NSC-612567, Warner-Lambert PALA, pentostatin, piritrexim, plicamycin, Asahi Chemical PL-AC, Takeda TAC-788, thioguanine, tiazofurin, Erbamont TIF, trimetrexate,

15 tyrosine kinase inhibitors, Taiho UFT and uricytin.

A second family of antineoplastic agents which may be used in combination with compounds of the present invention consists of alkylating-type antineoplastic agents. Suitable alkylating-type antineoplastic agents may be selected from

20 but not limited to the group consisting of Shionogi 254-S, aldo-phosphamide analogues, altretamine, anaxirone, Boehringer Mannheim BBR-2207, bestrabucil, budotitane, Wakunaga CA-102, carboplatin, carmustine, Chinoin-139, Chinoin-153, chlorambucil, cisplatin, cyclophosphamide,

25 American Cyanamid CL-286558, Sanofi CY-233, cyplatate, Degussa D-19-384, Sumimoto DACHP(Myrr)2, diphenylspiromustine, diplatinum cytostatic, Erba distamycin derivatives, Chugai DWA-2114R, ITI E09, elmustine, Erbamont FCE-24517, estramustine phosphate sodium, fotemustine,

30 Unimed G-6-M, Chinoin GYKI-17230, hepsul-fam, ifosfamide, iproplatin, lomustine, mafosfamide, mitolactol, Nippon Kayaku NK-121, NCI NSC-264395, NCI NSC-342215, oxaliplatin, Upjohn PCNU, prednimustine, Proter PTT-119, ranimustine, semustine, SmithKline SK&F-101772, Yakult Honsha SN-22,

spiromus-tine, Tanabe Seiyaku TA-077, tauromustine, temozolomide, teroxirone, tetraplatin and trimelamol.

A third family of antineoplastic agents which may be used in combination with compounds of the present invention consists of antibiotic-type antineoplastic agents. Suitable antibiotic-type antineoplastic agents may be selected from but not limited to the group consisting of Taiho 4181-A, aclarubicin, actinomycin D, actinoplanone, Erbamont ADR-456, aeroplysinin derivative, Ajinomoto AN-201-II, Ajinomoto AN-3, Nippon Soda anisomycins, anthracycline, azino-mycin-A, bisucaberin, Bristol-Myers BL-6859, Bristol-Myers BMY-25067, Bristol-Myers BMY-25551, Bristol-Myers BMY-26605, Bristol-Myers BMY-27557, Bristol-Myers BMY-28438, bleomycin sulfate, bryostatin-1, Taiho C-1027, caliche mycin, chromoximycin, dactinomycin, daunorubicin, Kyowa Hakko DC-102, Kyowa Hakko DC-79, Kyowa Hakko DC-88A, Kyowa Hakko DC89-A1, Kyowa Hakko DC92-B, ditrisarubicin B, Shionogi DOB-41, doxorubicin, doxorubicin-fibrinogen, elsamicin-A, epirubicin, erbstatin, esorubicin, esperamicin-A1, esperamicin-Alb, Erbamont FCE-21954, Fujisawa FK-973, fostriecin, Fujisawa FR-900482, glidobactin, gregatin-A, grincamycin, herbimycin, idarubicin, illudins, kazusamycin, kesarirhodins, Kyowa Hakko KM-5539, Kirin Brewery KRN-8602, Kyowa Hakko KT-5432, Kyowa Hakko KT-5594, Kyowa Hakko KT-6149, American Cyanamid LL-D49194, Meiji Seika ME 2303, menogaril, mitomycin, mitoxantrone, SmithKline M-TAG, neoactin, Nippon Kayaku NK-313, Nippon Kayaku NKT-01, SRI International NSC-357704, oxalysine, oxaunomycin, peplomycin, pilatin, pirarubicin, porothramycin, pyrindanycin A, Tobishi RA-I, rapamycin, rhizoxin, rodorubicin, sibanomicin, siwenmycin, Sumitomo SM-5887, Snow Brand SN-706, Snow Brand SN-07, sorangicin-A, sparsomycin, SS Pharmaceutical SS-21020, SS Pharmaceutical SS-7313B, SS Pharmaceutical SS-9816B, steffimycin B, Taiho 4181-2, talisomycin, Takeda TAN-868A, terpentecin, thiazine,

tricrozarin A, Upjohn U-73975, Kyowa Hakko UCN-10028A, Fujisawa WF-3405, Yoshitomi Y-25024 and zorubicin.

A fourth family of antineoplastic agents which may be used in combination with compounds of the present invention consists of a miscellaneous family of antineoplastic agents, including tubulin interacting agents, topoisomerase II inhibitors, topoisomerase I inhibitors and hormonal agents, selected from but not limited to the group consisting of  $\alpha$ -carotene,  $\alpha$ -difluoromethyl-arginine, acitretin, Biotec AD-5, Kyorin AHC-52, alstonine, amonafide, amphetinile, amsacrine, Angiostat, ankinomycin, anti-neoplaston A10, antineoplaston A2, antineoplaston A3, antineoplaston A5, antineoplaston AS2-1, Henkel APD, aphidicolin glycinate, asparaginase, Avarol, baccharin, batracylin, benfluron, benzotript, Ipsen-Beaufour BIM-23015, bisantrene, Bristol-Myers BMY-40481, Vestar boron-10, bromofosfamide, Wellcome BW-502, Wellcome BW-773, caracemide, carmethizole hydrochloride, Ajinomoto CDAF, chlorsulfaquinoxalone, Chemes CHX-2053, Chemex CHX-100, Warner-Lambert CI-921, Warner-Lambert CI-937, Warner-Lambert CI-941, Warner-Lambert CI-958, clanfenur, claviridenone, ICN compound 1259, ICN compound 4711, Contracan, Yakult Honsha CPT-11, crisnatol, curaderm, cytochalasin B, cytarabine, cytocytin, Merz D-609, DABIS maleate, dacarbazine, datelliptinium, didemnin-B, dihaematoporphyrin ether, dihydrolenperone, dinaline, distamycin, Toyo Pharmar DM-341, Toyo Pharmar DM-75, Daiichi Seiyaku DN-9693, docetaxel elliprabin, elliptinium acetate, Tsumura EPMTc, the epothilones, ergotamine, etoposide, etretinate, fenretinide, Fujisawa FR-57704, gallium nitrate, genkwadaphnin, Chugai GLA-43, Glaxo GR-63178, grifolan NMF-5N, hexadecylphosphocholine, Green Cross HO-221, homoharringtonine, hydroxyurea, BTG ICRF-187, ilmofosine, isoglutamine, isotretinoin, Otsuka JI-36, Ramot K-477, Otsuak K-76COONa, Kureha Chemical K-AM, MECT Corp KI-8110,



American Cyanamid L-623, leukoregulin, lonidamine, Lundbeck LU-23-112, Lilly LY-186641, NCI (US) MAP, marycin, Merrel Dow MDL-27048, Medco MEDR-340, merbarone, merocyanine derivatives, methylanilinoacridine, Molecular Genetics MGI-5 136, minactivin, mitonafide, mitoquinone mepidamol, motretinide, Zenyaku Kogyo MST-16, N-(retinoyl)amino acids, Nisshin Flour Milling N-021, N-acylated-dehydroalanines, nafazatrom, Taisho NCU-190, nocodazole derivative, Normosang, NCI NSC-145813, NCI NSC-361456, NCI NSC-604782, 10 NCI NSC-95580, ocreotide, Ono ONO-112, oquizarone, Akzo Org-10172, paclitaxel, pancratistatin, pazelliptine, Warner-Lambert PD-111707, Warner-Lambert PD-115934, Warner-Lambert PD-131141, Pierre Fabre PE-1001, ICRT peptide D, piroxantrone, polyhaematoporphyrin, polypreic acid, Efamol 15 porphyrin, probimane, procarbazine, proglumide, Invitron protease nexin I, Tobishi RA-700, razoxane, Sapporo Breweries RBS, restrictin-P, retelliptine, retinoic acid, Rhone-Poulenc RP-49532, Rhone-Poulenc RP-56976, SmithKline SK&F-104864, Sumitomo SM-108, Kuraray SMANCS, SeaPharm SP-20 10094, spatol, spirocyclopropane derivatives, spirogermanium, Unimed, SS Pharmaceutical SS-554, strypoldinone, Stypoldione, Suntory SUN 0237, Suntory SUN 2071, superoxide dismutase, Toyama T-506, Toyama T-680, taxol, Teijin TEI-0303, teniposide, thaliblastine, Eastman 25 Kodak TJB-29, tocotrienol, topotecan, Topostin, Teijin TT-82, Kyowa Hakko UCN-01, Kyowa Hakko UCN-1028, ukrain, Eastman Kodak USB-006, vinblastine sulfate, vincristine, vindesine, vinestramide, vinorelbine, vintriptyl, vinzolidine, withanolides and Yamanouchi YM-534.

30 Alternatively, the present compounds may also be used in co-therapies with other anti-neoplastic agents, such as acemannan, aclarubicin, aldesleukin, alemtuzumab, alitretinoin, altretamine, amifostine, aminolevulinic acid, amrubicin, amsacrine, anagrelide, anastrozole, ANCER,

2025-04-04 14:00:00

ancestim, ARGLABIN, arsenic trioxide, BAM 002 (Novelos),  
bexarotene, bicalutamide, broxuridine, capecitabine,  
celmoleukin, cetorelix, cladribine, clotrimazole,  
cytarabine ocfosfate, DA 3030 (Dong-A), daclizumab,  
5 denileukin diftitox, deslorelin, dexrazoxane, dilazep,  
docetaxel, docosanol, doxercalciferol, doxifluridine,  
doxorubicin, bromocriptine, carmustine, cytarabine,  
fluorouracil, HIT diclofenac, interferon alfa,  
daunorubicin, doxorubicin, tretinoin, edelfosine,  
10 edrecolomab, eflornithine, emitefur, epirubicin, epoetin  
beta, etoposide phosphate, exemestane, exisulind,  
fadrozole, filgrastim, finasteride, fludarabine phosphate,  
formestane, fotemustine, gallium nitrate, gemcitabine,  
gemtuzumab zogamicin, gimeracil/oteracil/tegafur  
15 combination, glycopine, goserelin, heptaplatin, human  
chorionic gonadotropin, human fetal alpha fetoprotein,  
ibandronic acid, idarubicin, (imiquimod, interferon alfa,  
interferon alfa, natural, interferon alfa-2, interferon  
alfa-2a, interferon alfa-2b, interferon alfa-N1, interferon  
20 alfa-n3, interferon alfacon-1, interferon alpha, natural,  
interferon beta, interferon beta-1a, interferon beta-1b,  
interferon gamma, natural interferon gamma-1a, interferon  
gamma-1b, interleukin-1 beta, iobenguane, irinotecan,  
irsogladine, lanreotide, LC 9018 (Yakult), leflunomide,  
25 lenograstim, lentinan sulfate, letrozole, leukocyte alpha  
interferon, leuprorelin, levamisole + fluorouracil,  
liarozole, lobaplatin, lonidamine, lovastatin, masoprocol,  
melarsoprol, metoclopramide, mifepristone, miltefosine,  
mirimostim, mismatched double stranded RNA, mitoguazone,  
30 mitolactol, mitoxantrone, molgramostim, nafarelin, naloxone  
+ pentazocine, nartograstim, nedaplatin, nilutamide,  
noscapine, novel erythropoiesis stimulating protein, NSC  
631570 octreotide, oprelvekin, osaterone, oxaliplatin,  
paclitaxel, pamidronic acid, pegaspargase, peginterferon

2025 RELEASE UNDER E.O. 14176

alpha-2b, pentosan polysulfate sodium, pentostatin,  
picibanil, pirarubicin, rabbit antithymocyte polyclonal  
antibody, polyethylene glycol interferon alpha-2a, porfimer  
sodium, raloxifene, raltitrexed, rasburicase, rhenium Re  
5 186 etidronate, RII retinamide, rituximab, romurtide,  
samarium (153 Sm) lexicidronam, sargramostim, sizofiran,  
sobuzoxane, sonermin, strontium-89 chloride, suramin,  
tasonermin, tazarotene, tegafur, temoporfin, temozolomide,  
teniposide, tetrachlorodecaoxide, thalidomide, thymalfasin,  
10 thyrotropin alfa, topotecan, toremifene, tositumomab-iodine  
131, trastuzumab, treosulfan, tretinoin, trilostane,  
trimetrexate, triptorelin, tumor necrosis factor alpha,  
natural, ubenimex, bladder cancer vaccine, Maruyama  
vaccine, melanoma lysate vaccine, valrubicin, verteporfin,  
15 vinorelbine, VIRULIZIN, zinostatin stimalamer, or  
zoledronic acid; abarelix; AE 941 (Aeterna), ambamustine,  
antisense oligonucleotide, bcl-2 (Genta), APC 8015  
(Dendreon), cetuximab, decitabine, dexaminoglutethimide,  
diaziquone, EL 532 (Elan), EM 800 (Endorecherche),  
20 eniluracil, etanidazole, fenretinide, filgrastim SD01  
(Amgen), fulvestrant, galocitabine, gastrin 17 immunogen,  
HLA-B7 gene therapy (Vical), granulocyte macrophage colony  
stimulating factor, histamine dihydrochloride, ibritumomab  
tiuxetan, ilomastat, IM 862 (Cytran), interleukin-2,  
25 iproxifene, LDI 200 (Milkhaus), leridistim, lintuzumab, CA  
125 MAb (Biomira), cancer MAb (Japan Pharmaceutical  
Development), HER-2 and Fc MAb (Medarex), idiotypic 105AD7  
MAb (CRC Technology), idiotypic CEA MAb (Trilex), LYM-1-  
iodine 131 MAb (Techniclone), polymorphic epithelial mucin-  
30 yttrium 90 MAb (Antisoma), marimastat, menogaril,  
mitumomab, motexafin gadolinium, MX 6 (Galderma),  
nelarabine, nolatrexed, P 30 protein, pegvisomant,  
pemetrexed, porfiromycin, prinomastat, RL 0903 (Shire),  
rubitecan, satraplatin, sodium phenylacetate, sparfosic

2004032404

acid, SRL 172 (SR Pharma), SU 5416 (SUGEN), TA 077

(Tanabe), tetrathiomolybdate, thaliblastine,

thrombopoietin, tin ethyl etiopurpurin, tirapazamine,

cancer vaccine (Biomira), melanoma vaccine (New York

5 University), melanoma vaccine (Sloan Kettering Institute),  
melanoma oncolysate vaccine (New York Medical College),  
viral melanoma cell lysates vaccine (Royal Newcastle  
Hospital), or valspodar.

Alternatively, the present compounds may also be used  
10 in co-therapies with other anti-neoplastic agents, such as  
other kinase inhibitors including p38 inhibitors and CDK  
inhibitors, TNF inhibitors, metallomatrix proteases  
inhibitors (MMP), COX-2 inhibitors including celecoxib,  
rofecoxib, parecoxib, valdecoxib, and etoricoxib, NSAID's,  
15 SOD mimics or  $\alpha\beta_3$  inhibitors.

The present invention comprises processes for the preparation of a compound of Formulas I-III.

Also included in the family of compounds of Formulas I-III are the pharmaceutically-acceptable salts thereof. The term "pharmaceutically-acceptable salts" embraces salts commonly used to form alkali metal salts and to form addition salts of free acids or free bases. The nature of the salt is not critical, provided that it is pharmaceutically-acceptable. Suitable pharmaceutically-acceptable acid addition salts of compounds of Formulas I-III may be prepared from an inorganic acid or from an organic acid. Examples of such inorganic acids are hydrochloric, hydrobromic, hydroiodic, nitric, carbonic, sulfuric and phosphoric acid. Appropriate organic acids may be selected from aliphatic, cycloaliphatic, aromatic, arylaliphatic, heterocyclic, carboxylic and sulfonic classes of organic acids, example of which are formic, acetic, adipic, butyric, propionic, succinic, glycolic, gluconic, lactic, malic, tartaric, citric, ascorbic, glucuronic,

maleic, fumaric, pyruvic, aspartic, glutamic, benzoic, anthranilic, mesylic, 4-hydroxybenzoic, phenylacetic, mandelic, embonic (pamoic), methanesulfonic, ethanesulfonic, ethanedisulfonic, benzenesulfonic, pantothenic, 2-

5 hydroxyethanesulfonic, toluenesulfonic, sulfanilic, cyclohexylaminosulfonic, camphoric, camphorsulfonic, digluconic, cyclopentanepropionic, dodecylsulfonic, glucoheptanoic, glycerophosphonic, heptanoic, hexanoic, 2-

10 hydroxy-ethanesulfonic, nicotinic, 2-naphthalenesulfonic, oxalic, palmoic, pectinic, persulfuric, 2-phenylpropionic, picric, pivalic propionic, succinic, tartaric, thiocyanic, mesylic, undecanoic, stearic, algenic,  $\beta$ -hydroxybutyric, salicylic, galactaric and galacturonic acid. Suitable

15 pharmaceutically-acceptable base addition salts of compounds of Formulas I-III include metallic salts, such as salts made from aluminum, calcium, lithium, magnesium, potassium, sodium and zinc, or salts made from organic bases including primary, secondary and tertiary amines, substituted amines including cyclic amines, such as caffeine, arginine,

20 diethylamine, N-ethyl piperidine, histidine, glucamine, isopropylamine, lysine, morpholine, N-ethyl morpholine, piperazine, piperidine, triethylamine, trimethylamine. All of these salts may be prepared by conventional means from the corresponding compound of the invention by reacting, for

25 example, the appropriate acid or base with the compound of Formulas I-III.

2025 RELEASE UNDER E.O. 14176

Also, the basic nitrogen-containing groups can be quaternized with such agents as lower alkyl halides, such as methyl, ethyl, propyl, and butyl chloride, bromides and iodides; dialkyl sulfates like dimethyl, diethyl, dibutyl, and diamyl sulfates, long chain halides such as decyl, lauryl, myristyl and stearyl chlorides, bromides and iodides, aralkyl halides like benzyl and phenethyl bromides, and others. Water or oil-soluble or dispersible products are thereby obtained.

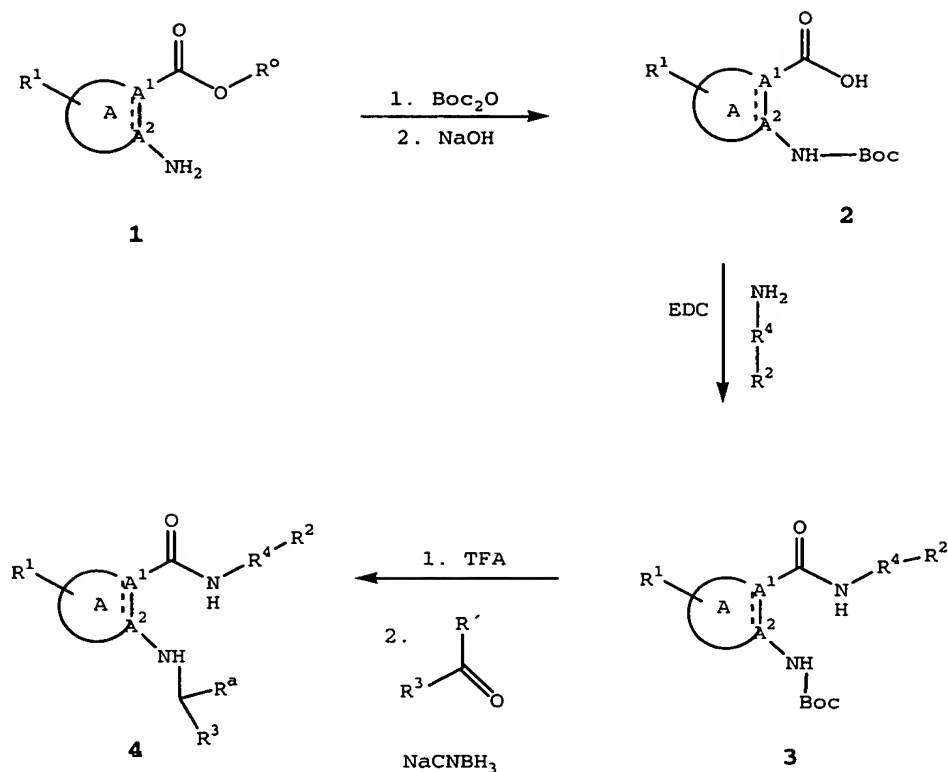
Examples of acids that may be employed to form pharmaceutically acceptable acid addition salts include such inorganic acids as hydrochloric acid, sulphuric acid and phosphoric acid and such organic acids as oxalic acid, maleic acid, succinic acid and citric acid. Other examples include salts with alkali metals or alkaline earth metals, such as sodium, potassium, calcium or magnesium or with organic bases. Preferred salts include hydrochloride, phosphate and edisylate.

Additional examples of such salts can be found in Berge et al., J. Pharm. Sci., 66, 1 (1977).

#### GENERAL SYNTHETIC PROCEDURES

The compounds of the invention can be synthesized according to the following procedures of Schemes 1-43, wherein the substituents are as defined for Formulas I-III, above, except where further noted.

Scheme 1



5

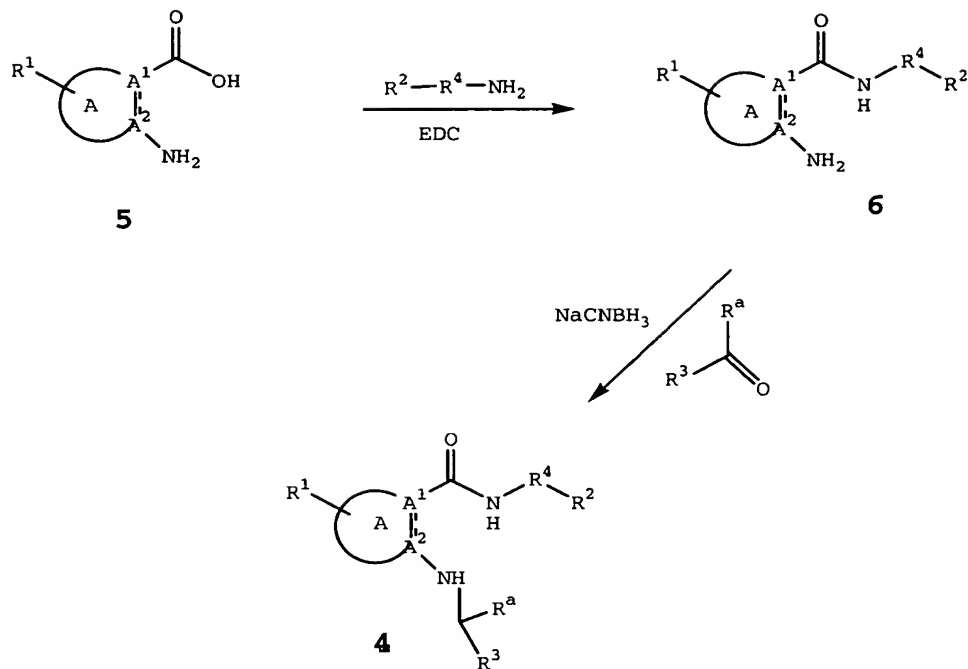
Cyclic amides can be prepared according to the method set out in Scheme 1. The amino group of compound 1 (where R<sup>o</sup> is alkyl, aryl, and the like) is protected, such as with Boc anhydride, followed by treatment, to remove the ester, such as with base, forming the protected amine/free acid 2. Alternatively, other amino protecting groups known in the art can be used. Substitued amines are coupled with the free acid, such as with EDC, to form the protected amine/amide 3. The protected amine moiety is removed, such as with acid, and reacted via one step reductive alkylation with carbonyl-containing compounds to form the 1-amido-2-substituted amino-compounds 4. Preferably the amination is in an alcohol, such as MeOH, EtOH or propanol, and at a temperature between about 0-50°C, such as RT. Aldehydes or ketones are preferred carbonyl-containing compounds.

20

Alternative carbonyl-containing compounds are, for example, bisulfite adducts or semiacetals, acetals, semiketals or ketals of compounds with alcohols, for example lower hydroxyalkyl compounds; or thioacetals or thioketals of compounds with mercaptans, for example lower alkylthio compounds. The reductive alkylation is preferably carried out with hydrogenation in the presence of a catalyst, such as platinum or especially palladium, which is preferably bonded to a carrier material, such as carbon, or a heavy metal catalyst, such as Raney nickel, at normal pressure or at pressures of from 0.1 to 10 MegaPascal (MPa), or with reduction by means of complex hydrides, such as borohydrides, especially alkali metal cyanoborohydrides, for example sodium cyanoborohydride, in the presence of a suitable acid, preferably relatively weak acids, such as lower alkylcarboxylic acids, especially acetic acid, or a sulfonic acid, such as p-toluenesulfonic acid; in customary solvents, for example alcohols, such as methanol or ethanol, or ethers, for example cyclic ethers, such as tetrahydrofuran, in the presence or absence of water.



Schem 2



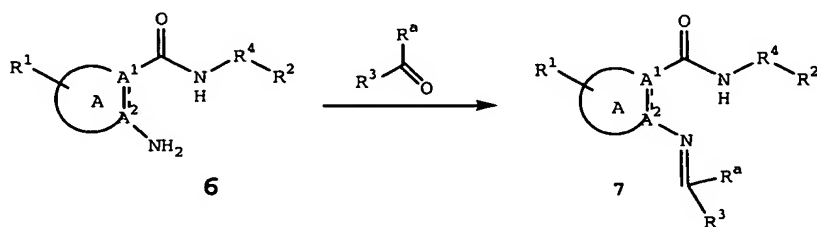
5

Alternatively, compounds **4** can be prepared from mixed acid/amines **5** as shown in Scheme 2. Substituted amines are coupled with the mixed acid/amines **5** such as with a coupling reagent, for example EDC, to form the mixed amine/amide **6**.

10 Substituted carbonyl compounds, such as acid halides, anhydrides, carboxylic acids, esters, ketones, aldehydes and the like, are added to the mixed amine/amide **6** followed with reduction to give the substituted amide/substituted amine compounds **4**.

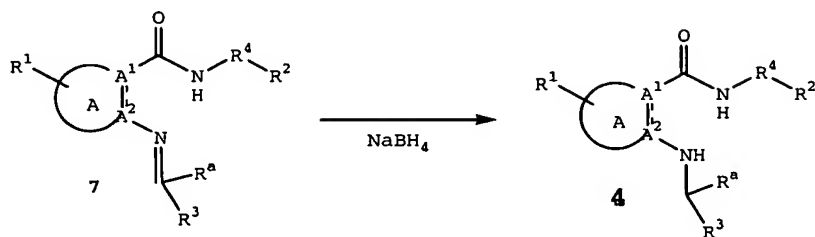
15

Scheme 3



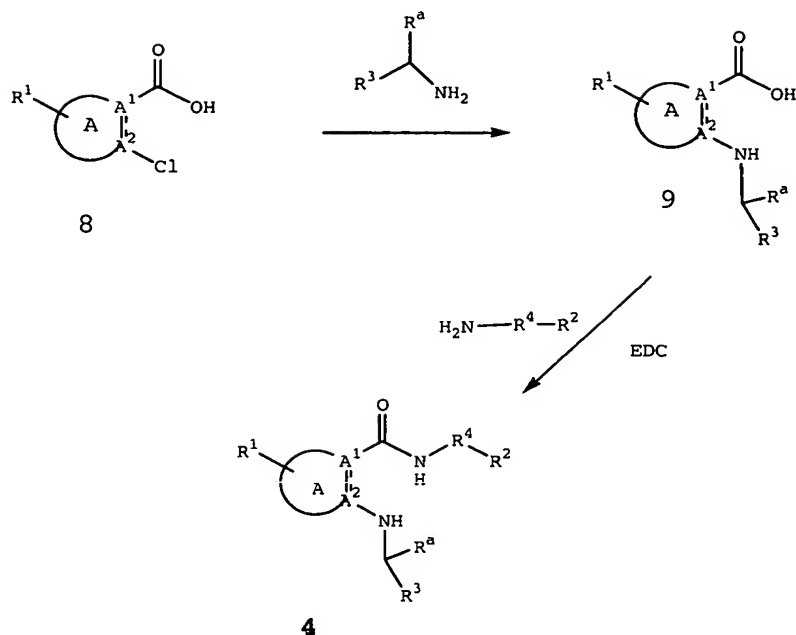
Imino compounds **7** can be formed from the mixed amine/amides **6**, such as by reacting with a substituted carbonyl compound.

5

**Scheme 4**

- 10 Substituted cyclic carboxamides can be prepared from the corresponding imino analogs by the process outlined in Scheme 4. Treatment of the imino compound **7** with a reducing agent yields compound **4**. Reagents which can be used to add hydrogen to an imine double bond include borane in THF,
- 15 LiAlH<sub>4</sub>, NaBH<sub>4</sub>, sodium in EtOH and hydrogen in the presence of a catalyst, among others.

## Scheme 5



5            Substituted carboxamides **4** can be prepared from the  
corresponding halo analogs **8** by the process outlined in  
Scheme 5. Substituted amino acids **9** are prepared from the  
corresponding chloro compounds **8** such as by reacting with an  
amine at a suitable temperature, such as about 80°C. The  
10    acid **9** is coupled with an amine, preferably in the presence  
of a coupling agent such as EDC, to form the corresponding  
amide **4**.

          The amination process can be carried out as an Ullmann  
type reaction using a copper catalyst, such as copper[0] or  
15    a copper[I] compound such as copper[I]oxide,  
copper[I]bromide or copper[I]iodide in the presence of a  
suitable base (such as a metal carbonate, for example K<sub>2</sub>CO<sub>3</sub>)  
to neutralize the acid generated in the reaction. This  
reaction is reviewed in Houben-Weyl "Methoden der  
20    Organischen Chemie", Band 11/1, page 32 -33, 1958, in  
Organic Reactions, 14, page 19-24, 1965 and by J. Lindley  
(1984) in Tetrahedron, 40, page 1433-1456. The amount of

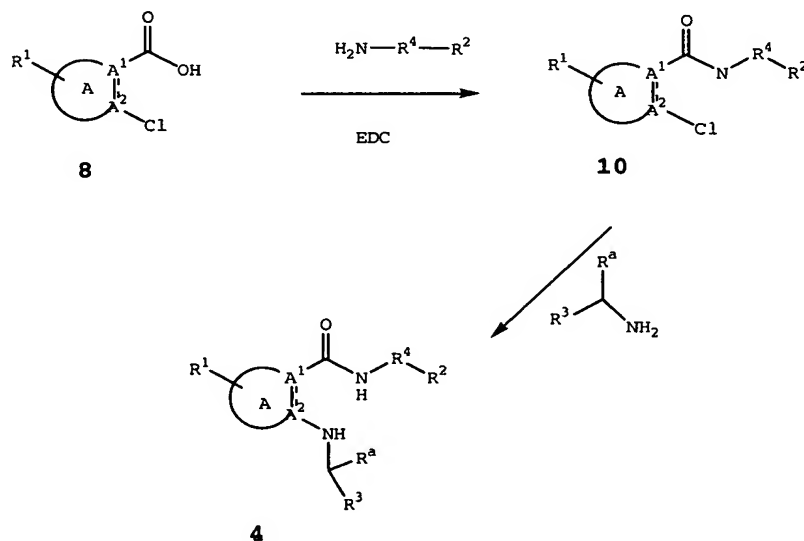
catalyst is typically in the range of 1 to 20 mole percent. The reaction is carried out in an inert, aprotic solvent such as an ether (for example dimethoxyethane or dioxane) or an amide (for example dimethylformamide or *N*-methylpyrrolidone), under an inert atmosphere in the temperature range of 60-180°C.

An alternative amination process involves using a Group VIII element, where the metal core of the catalyst should be a zero-valent transition metal, such as palladium or nickel, which has the ability to undergo oxidative addition to the aryl-halogen bond. The zero valent state of the metal may be generated in situ from the M[II] state. The catalyst complexes may include chelating ligands, such as alkyl, aryl or heteroaryl derivatives of phosphines or biphosphines, imines or arsines. Preferred catalysts contain palladium or nickel. Examples of such catalysts include palladium[II]chloride, palladium[II]acetate, tetrakis(triphenyl-phosphine)palladium[0] and nickel[II]acetylacetonate. The metal catalyst is typically in the range of 0.1 to 10 mole percent. The chelating ligands may be either monodentate, as in the case for example of trialkylphosphines, such as tributylphosphine, triarylphosphines, such as tri-(*ortho*-tolyl)phosphine, and triheteroaryl phosphines, such as tri-2-furylphosphine; or they may be bidentate such as in the case of 2,2'-bis(diphenylphosphino)-1,1'-binaphthyl, 1,2-bis(diphenylphosphino)ethane, 1,1'-bis(diphenylphosphino)ferrocene and 1-(*N,N*-dimethyl-amino)-1'-(dicyclohexylphosphino)biphenyl. The supporting ligand may be complexed to the metal center in the form of a metal complex prior to being added to the reaction mixture or may be added to the reaction mixture as a separate compound. The supporting ligand is typically present in the range 0.01 to 20 mole percent. It is often necessary to add a suitable

base to the reaction mixture, such as a trialkylamine (for example DIEA or 1,5-diazabicyclo[5,4,0]undec-5-ene), a Group I alkali metal alkoxide (for example potassium *tert*-butoxide) or carbonate (for example cesium carbonate) or potassium phosphate. The reaction is typically carried out in an inert aprotic solvent such as an ether (for example dimethoxyethane or dioxane) or an amide (for example DMF or *N*-methylpyrrolidone), under an inert atmosphere in the temperature range of 60-180°C.

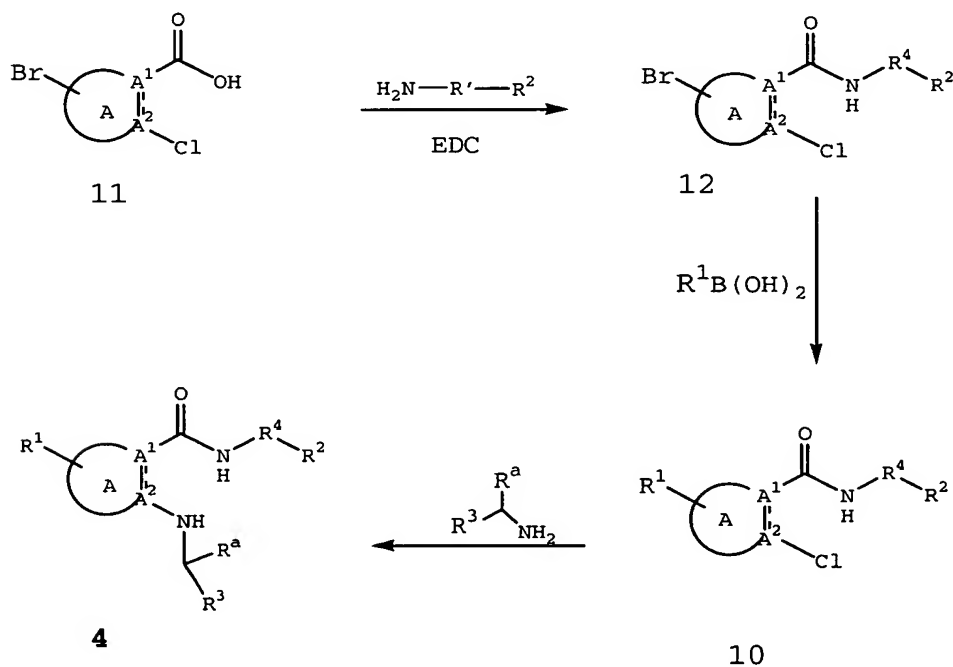
The amination is preferably carried out in an inert, aprotic, preferably anhydrous, solvent or solvent mixture, for example in a carboxylic acid amide, for example dimethylformamide or dimethylacetamide, a cyclic ether, for example THF or dioxane, or a nitrile, for example CH<sub>3</sub>CN, or in a mixture thereof, at an appropriate temperature, for example in a temperature range of from about 40°C to about 180°C, and if necessary under an inert gas atmosphere, for example a nitrogen or argon atmosphere.

Scheme 6



Substituted carboxamides **4** can be prepared from the corresponding halo analogs **8** by the process outlined in Scheme 6. The chloro acid **8** is coupled with an amine, preferably in the presence of a coupling agent such as EDC, to form the corresponding chloro amide **10**. Substituted amino-amides **4** are prepared from the corresponding chloro compounds **10** such as by reacting with an amine at a suitable temperature, such as about 80°C. The amination reaction can be run in the presence of an appropriate catalyst such as a palladium catalyst, in the presence of an aprotic base such as sodium *t*-butoxide or cesium carbonate, or a nickel catalyst, or a copper catalyst.

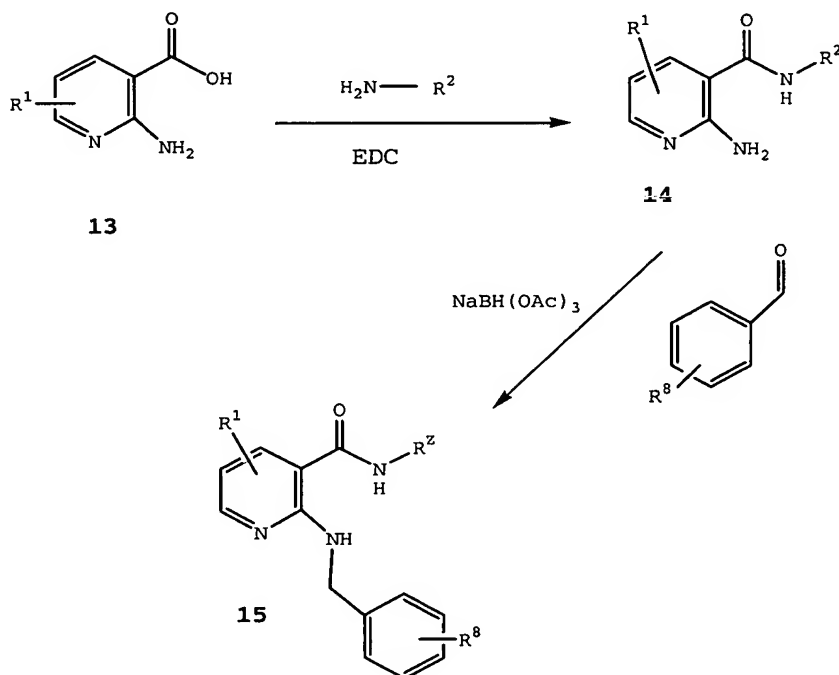
Scheme 7



Substituted carboxamides **4** can be prepared from the corresponding bromo/chloro analogs **11** by the process outlined in Scheme 7. The bromo/chloro acid **11** is coupled with an amine, preferably in the presence of a coupling

agent such as EDC, to form the corresponding bromo substituted amide **12**. Suzuki coupling with the bromo amide **12** and suitable boronic acids provides the substituted amide **10**. Substituted amino-amides **4** are prepared from the  
5 corresponding chloro compounds **10** as described in Scheme 6.

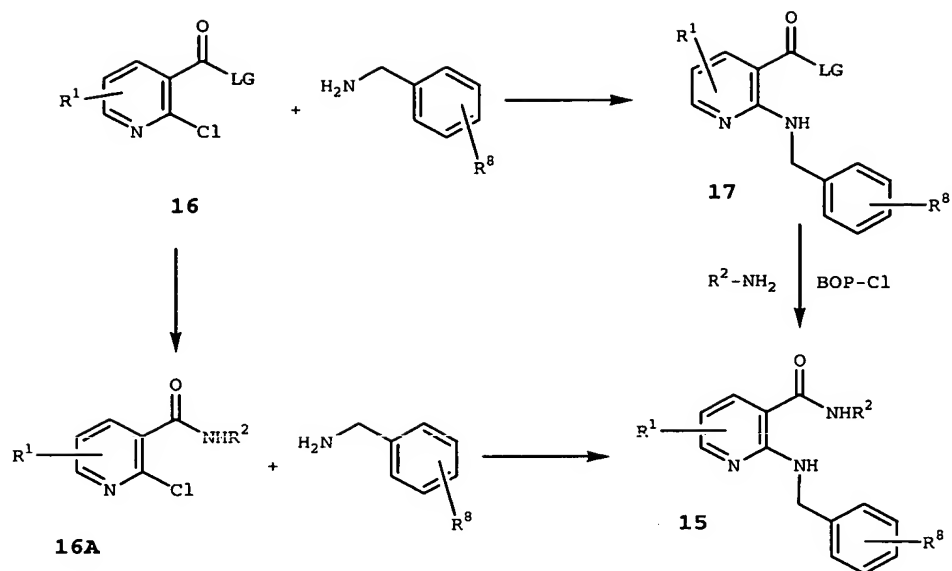
Scheme 8



10

Substituted pyridines can be prepared such as by the method found in Scheme 8. 2-Aminonicotinic acid **13** is coupled with a substituted amine at a suitable temperature, nonprotic solvent such as  $\text{CH}_2\text{Cl}_2$ , such as with EDC and HOBT, to form the nicotinamide **14**. The nicotinamide **14** is  
15 reductively alkylated such as with substituted 4-benzaldehydes and  $\text{NaBH}(\text{OAc})_3$ , to yield the 2-substituted amino-pyridyl carboxamides **15**.

Schem 9



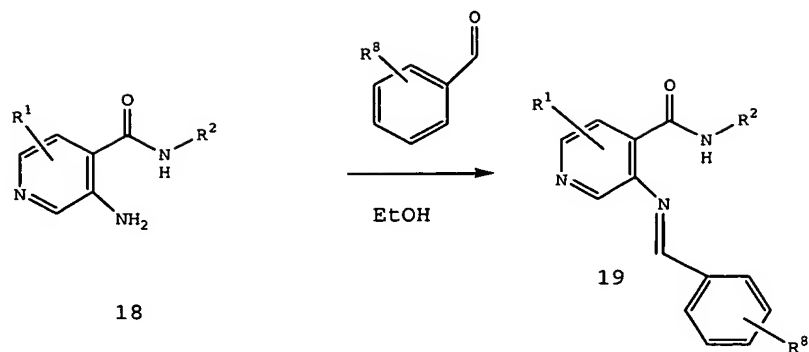
5

Substituted pyridines may be prepared by the method found in Scheme 9. 2-Chloro-nicotinic acid **16** (where LG is OH) is coupled with an amine at a suitable temperature, such as a temperature over about 100°C to give the 2-substituted amino-nicotinic acid **17**. The 2-substituted amino-nicotinic acid **17** is reacted with a substituted amine in the presence of a coupling reagent, such as BOP-Cl and base, such as TEA to form the 2-substituted amino-nicotinamide **15**.

Alternatively, 2-chloro-nicotinoyl chloride (LG is Cl) is coupled first with R<sup>2</sup>-NH<sub>2</sub>, such as in the presence of base, e.g., NaHCO<sub>3</sub>, in a suitable solvent, such as CH<sub>2</sub>Cl<sub>2</sub>, to form the amide **16A**, then coupled with a benzylamine to yield the 2-substituted amino-nicotinamide **15**.



## Scheme 10

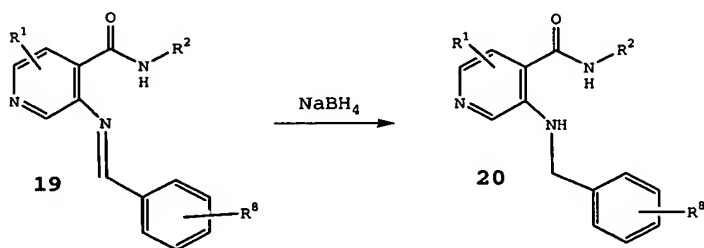


5

Imino-substituted pyridines may be prepared by the method found in Scheme 10. (2-Amino-(4-pyridyl))-carboxamide **18** is reacted with substituted 4-benzaldehydes, such as in the presence of p-toluenesulfonic acid monohydrate to yield the imino compound **19**.

10

## Scheme 11

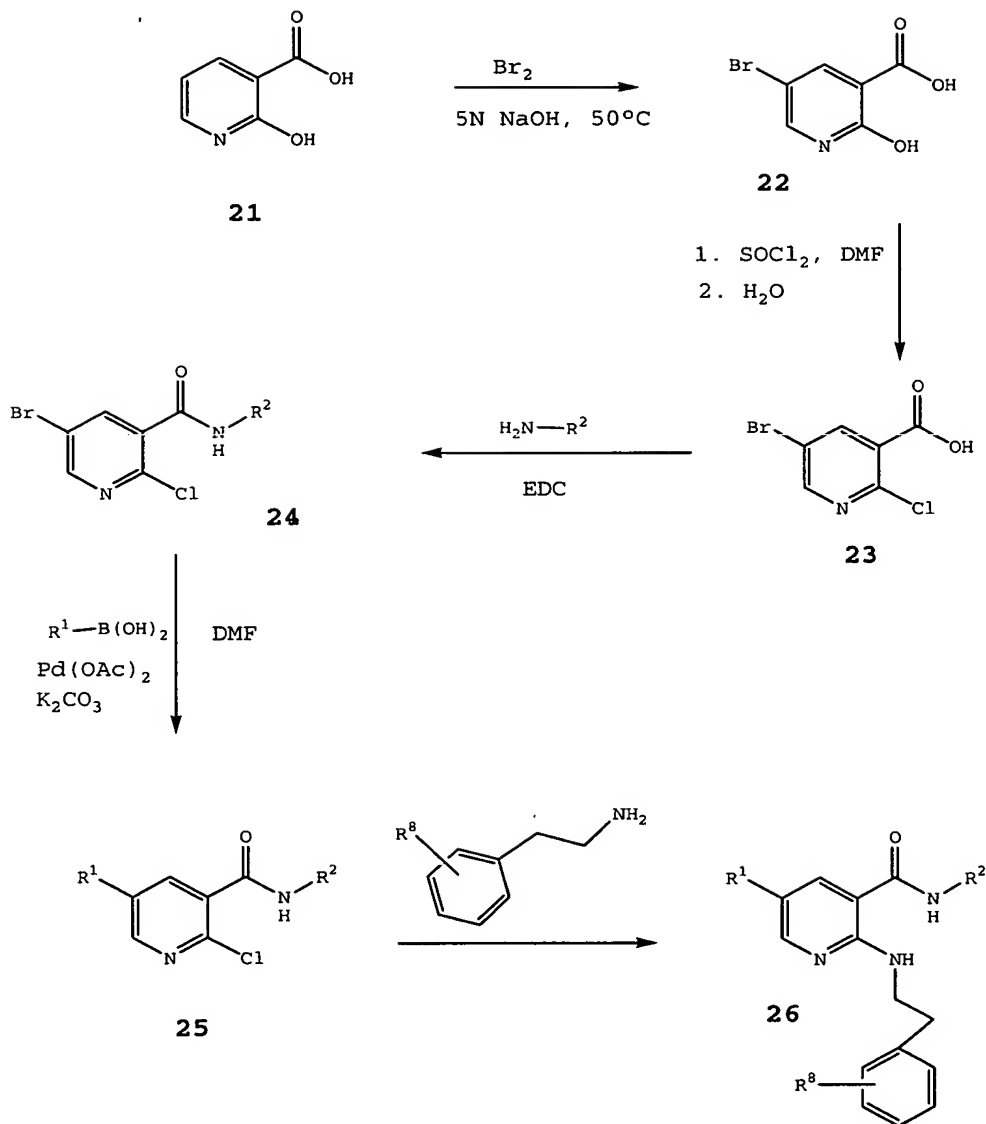


15

Substituted pyridines alternatively may be prepared by the method found in Scheme 11. The imino compound **19** is reduced, such as with NaBH<sub>4</sub>, to form the substituted amine **20**.

20

Scheme 12



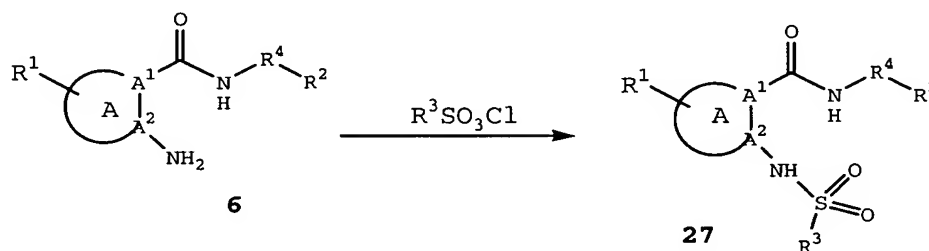
5

Substituted pyridines can be prepared by the process outlined in Scheme 12. A solution of sodium hypobromite is freshly prepared and added to 2-hydroxynicotinic acid **21** and heated, preferably at a temperature at about 50°C.

10 Additional hypobromite solution may be needed to form the bromo compound **22**. The 5-bromo-2-hydroxynicotinic acid **22**

is reacted with thionyl chloride, preferably at a temperature  $>RT$ , more preferably at about  $80^{\circ}C$  to form the 2-chloro-nicotinic acid analog **23**. The acid is coupled with an amine, preferably in the presence of EDC, HOBT, and DIEA to form the corresponding substituted amide **24**. Suzuki coupling with the bromo amide and suitable boronic acids, provides the substituted nicotinamide **25**. 2-Amino-nicotinamides **26** are prepared from the corresponding chloro compounds **25** such as by reacting with substituted amines at a suitable temperature, such as about  $80^{\circ}C$ .

Scheme 13



15

Alternatively, sulfonamides **27** can be prepared from amines **6** as shown in Scheme 13. Substituted sulfonyl compounds, such as sulfonyl halides, preferably chloro or bromo, sulfonic acids, an activated ester or reactive anhydride, or in the form of a cyclic amide, and the like, are added to the amine **6** to give the sulfonamide compounds **27**.

The reaction is carried out in a suitable solvent, such as  $CH_2Cl_2$ , at a temperature between about  $RT$  to about the reflux temperature of the solvent, in the presence of a suitable base, such as DIEA or DMAP.

The amino group of compounds **6** is preferably in free form, especially when the sulfonyl group reacting therewith is present in reactive form. The amino group may, however, itself be a derivative, for example by reaction with a

20250923 09:40:00

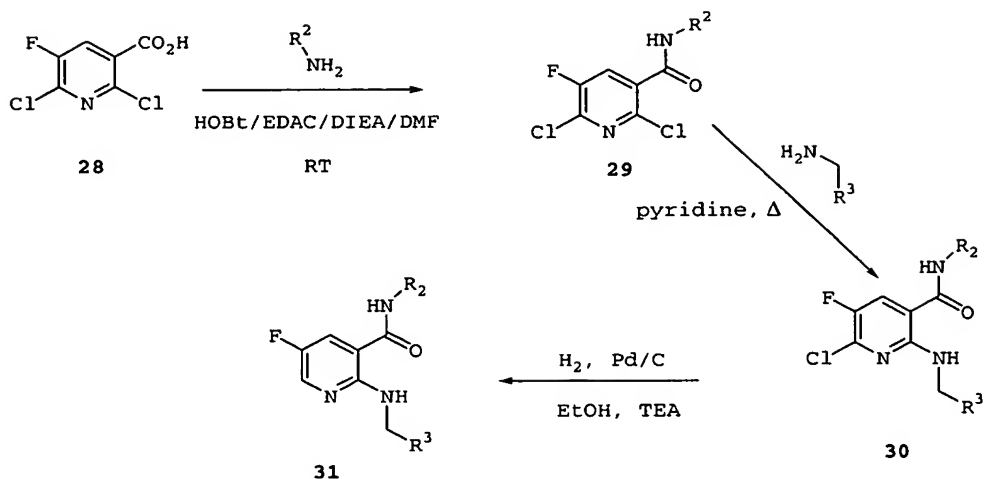
phosphite, such as diethylchlorophosphite, 1,2-phenylene chlorophosphite, ethyldichlorophosphite, ethylene chlorophosphite or tetraethylpyrophosphite. A derivative of such a compound having an amino group also can be a carbamic acid halide or an isocyanate.

The condensation of activated sulfonic esters, reactive anhydrides or reactive cyclic amides with the corresponding amines is customarily carried out in the presence of an inorganic base, such as an alkaline metal hydrogen carbonate or carbonate, or especially an organic base, for example simple lower (alkyl)<sub>3</sub>-amines, for example TEA or tributylamine, or one of the above-mentioned organic bases. If desired, a condensation agent is additionally used, for example as described for free carboxylic acids.

The condensation is preferably carried out in an inert, aprotic, preferably anhydrous, solvent or solvent mixture, for example in a carboxylic acid amide, for example formamide or DMF, a halogenated hydrocarbon, for example CH<sub>2</sub>Cl<sub>2</sub>, CCl<sub>4</sub> or chlorobenzene, a ketone, for example acetone, a cyclic ether, for example THF or dioxane, an ester, for example EtOAc, or a nitrile, for example CH<sub>3</sub>CN, or in a mixture thereof, as appropriate at reduced or elevated temperature, for example in a temperature range of from about -40°C to about 100°C, preferably from about -10°C to about 70°C, and when arylsulfonyl esters are used also at temperatures of from about 10-30°C, and if necessary under an inert gas atmosphere, for example a nitrogen or argon atmosphere.

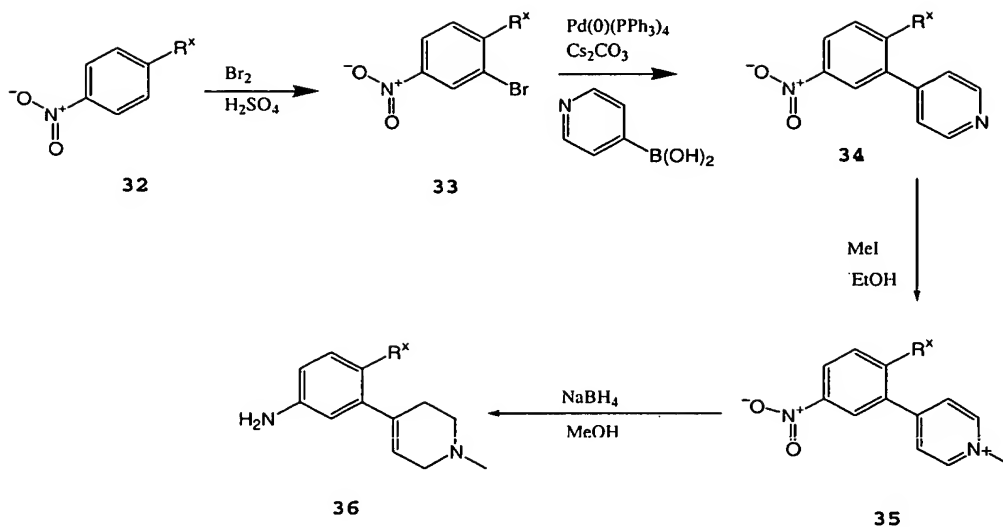
Alcoholic solvents, for example EtOH, or aromatic solvents, for example benzene or toluene, may also be used. When alkali metal hydroxides are present as bases, acetone may also be added where appropriate.

Scheme 14



- 5 Substituted pyridines can be prepared by the process outlined in Scheme 14. 2-Chloronicotinic acid **28** and substituted amine are coupled under conditions similar to that described in the previous schemes to give the amide **29**.
- 10 6-Chloro-2-aminopyridines **30** are prepared from the amide **29**, such as by reacting with substituted amines at a suitable temperature, such as above about 80°C, preferably above about 100°C, more preferably at about 130°C, neat. 6-Chloro-2-aminopyridines **30** are de-chlorinated such as by hydrogenation, for example by treatment with H<sub>2</sub> in the
- 15 presence of Pd/C, to yield other compounds of the present invention **31**.

## Scheme 15

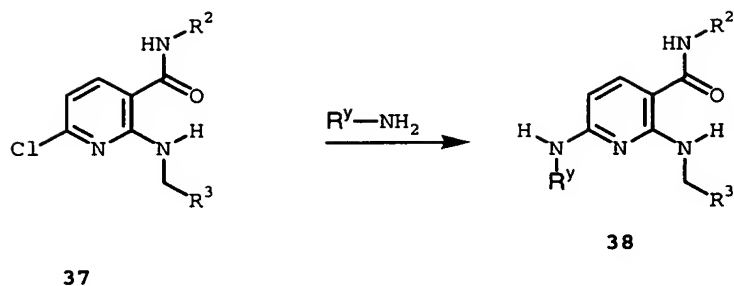


5

1,2,3,6-Tetrahydro-pyridyl substituted anilines (where  $R^x$  is a substituent selected from those available for substituted  $R^2$ ) are prepared such as by the procedure described in Scheme 15. Nitrobenzenes **32** are brominated, such as with bromine in the presence of acid,  $H_2SO_4$  for example, or with NBS to yield the 3-bromo derivative **33**. Suzuki coupling of the bromo-derivative **33** and a substituted pyridylboronic acid, such as at a temperature above RT, preferably above about  $50^\circ C$ , and more preferably at about  $80^\circ C$ , yields the pyridyl derivative **34**. Alkylation of the nitrophenyl-pyridine **34**, such as by treatment with iodomethane, preferably above about  $50^\circ C$ , and more preferably at about  $80^\circ C$ , yields the pyridinium compound **35**, which upon reduction, such as by  $NaBH_4$ , yields the tetrahydropyridine **36**.

20

Scheme 16

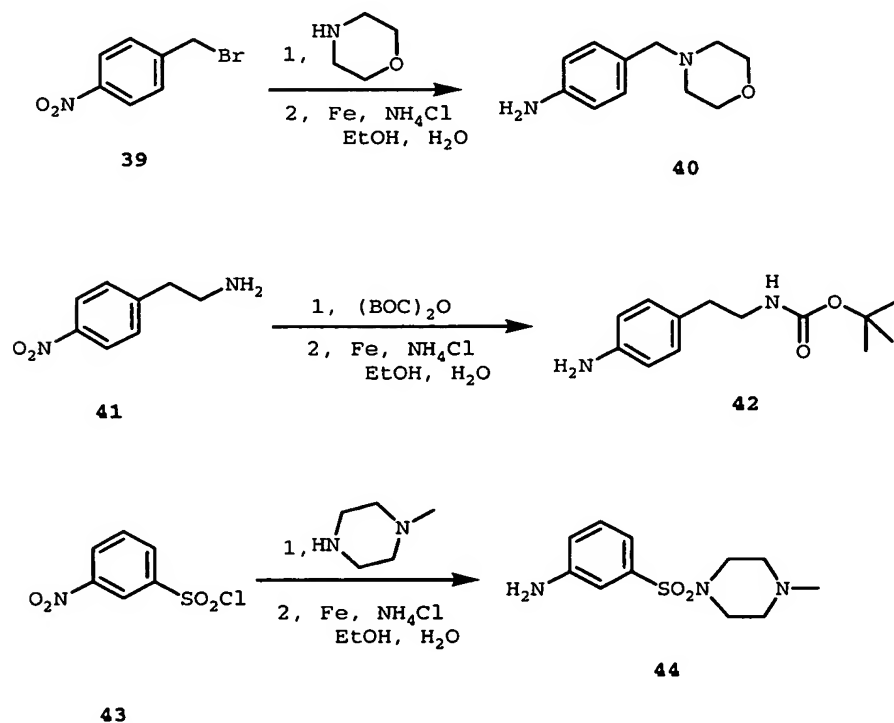


5

6-Amino substituted pyridines are prepared such as by the procedure described in Scheme 16. Similar to the method of Scheme 13, chloropyridine **37** and is reacted with an amine, preferably above about 50°C, and more preferably at about 80°C, to yield the 6-aminopyridines **38**.

10

Scheme 17



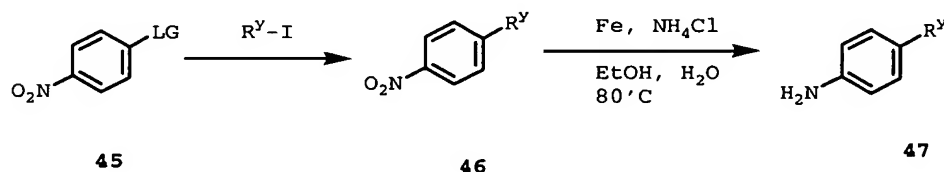
15

A series of substituted anilines are prepared such as by the procedure described in Scheme 17. A nitrobenzyl bromide **39** is coupled with morpholine, such as at a temperature at about RT, to yield the heterocyclylmethyl nitrobenzene derivative. Reduction of the nitro compound, such as with iron powder, preferably above about 50°C, and more preferably at about 80°C, yields the heterocyclylmethyl substituted aniline **40**.

Protected alkylamine substituted anilines can be prepared from the nitro free amines **41**, such as with standard protecting agents and chemistry known in the art, such as BOC chemistry. Reduction of the protected nitro compound, such as with iron powder, preferably above about 50°C, and more preferably at about 80°C, yields the aniline **42**.

Sulfonamide substituted anilines can be prepared from nitrobenzenesulfonyl chlorides **43**. Coupling of nitrobenzenesulfonyl chlorides **43** with reactive heterocyclic compounds, such as substituted piperazines, piperidines, and the like, in a protic solvent such as EtOH, such as at a temperature about RT, yields the nitrobenzenesulfonamides **43**. Reduction of the nitro benzenesulfonamide, such as with iron powder, preferably above about 50°C, and more preferably at about 80°C, yields the aniline **44**.

Scheme 18



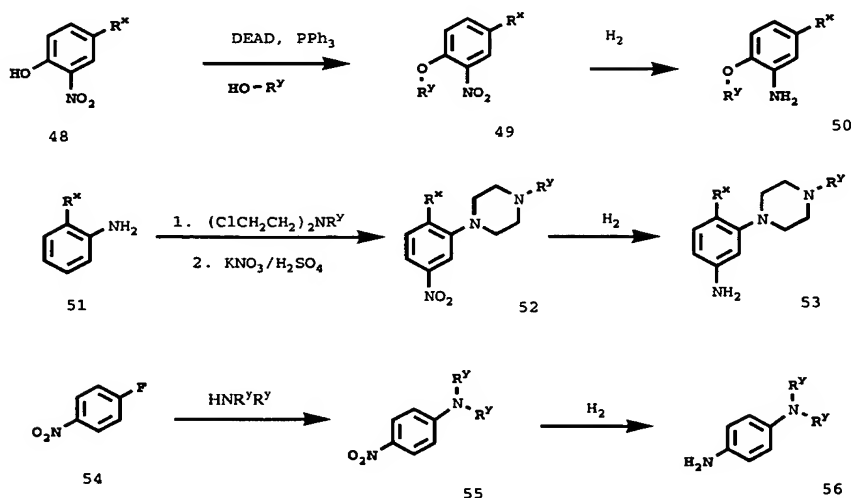
A series of perhaloalkyl-substituted anilines **47**, where  $\text{R}^y$  represents perhaloalkyl radicals, are prepared such



as by the procedure described in Scheme 18. 1-Nitro-4-(perfluoroethyl)benzene can be synthesized by the method described in the reference [John N. Freskos, Synthetic Communications, 18(9), 965-972 (1988)]. Alternatively, 1-Nitro-4-(perfluoroalkyl)benzene can be synthesized from the nitro compound, where LG is a leaving group, such as iodo, by the method described by W. A. Gregory, et al. [J. Med. Chem., 1990, 33, 2569-2578].

Reduction of the nitrobenzenes **46**, such as with iron powder, at a temperature above about 50°C, and preferably at about 80°C, yields the aniline **47**. Hydrogenation, such as with H<sub>2</sub> atmosphere in the presence of catalyst, such as 10% Pd/C, is also possible.

Scheme 19



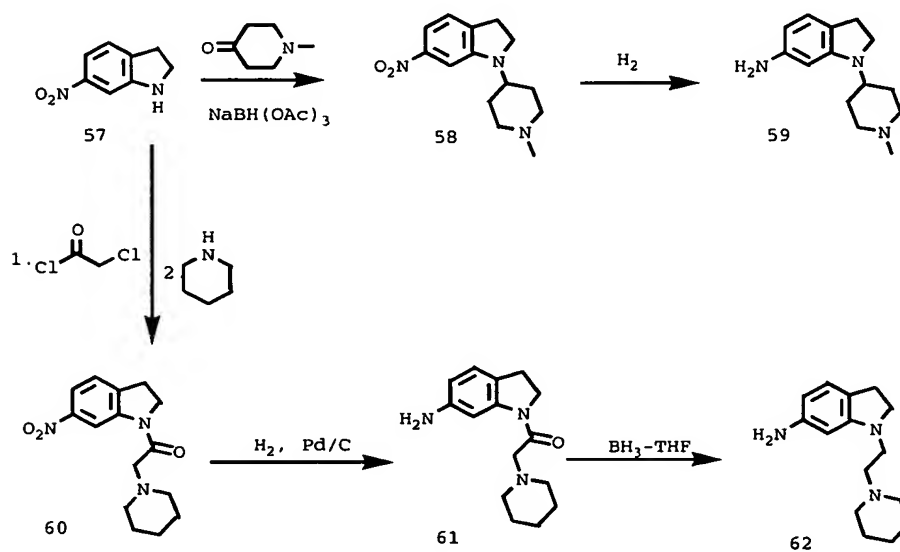
Additional series of substituted anilines (where  $R^X$  is a substituent selected those available for substituted  $R^2$ ) - are prepared such as by the procedures described in Scheme 19. 2-Alkoxy substituted anilines **50** are prepared from the corresponding phenol compounds **48** such as by the Mitsunobu reaction, including treatment with a N,N-dialkylethanolamine and  $\text{PPh}_3$  and DEAD to give the corresponding nitro compound

49, followed by hydrogenation, such as with  $H_2$  to give the aniline 50.

Alternatively, piperazinyl substituted anilines 53 can be prepared by the treatment of an aniline 51 with an N-substituted-bis(2-chloroethyl)amine, base, such as  $K_2CO_3$  and NaI, at a temperature above about  $50^\circ C$ , preferably above about  $100^\circ C$ , and more preferably at about  $170^\circ C$ , to give the piperazinylbenzene compound 52. Nitration, such as with  $H_2SO_4$  and  $KNO_3$ , at a temperature above  $0^\circ C$ , and preferably at about RT, followed by hydrogenation, such as with  $H_2$  atmosphere gives the substituted aniline 53.

Alternatively, piperazinyl substituted anilines 56 can be prepared by the treatment of a fluoro-nitro-substituted aryl compounds 54. The fluoro-nitro-substituted aryl compounds 54 and 1-substituted piperazines are heated, preferably neat, at a temperature above about  $50^\circ C$ , and preferably at about  $90^\circ C$ , to yield the piperazinyl-nitroaryl compounds 55. Hydrogenation, such as with  $H_2$  atmosphere in the presence of a catalyst, such as 10% Pd/C, gives the substituted aniline 56.

Scheme 20



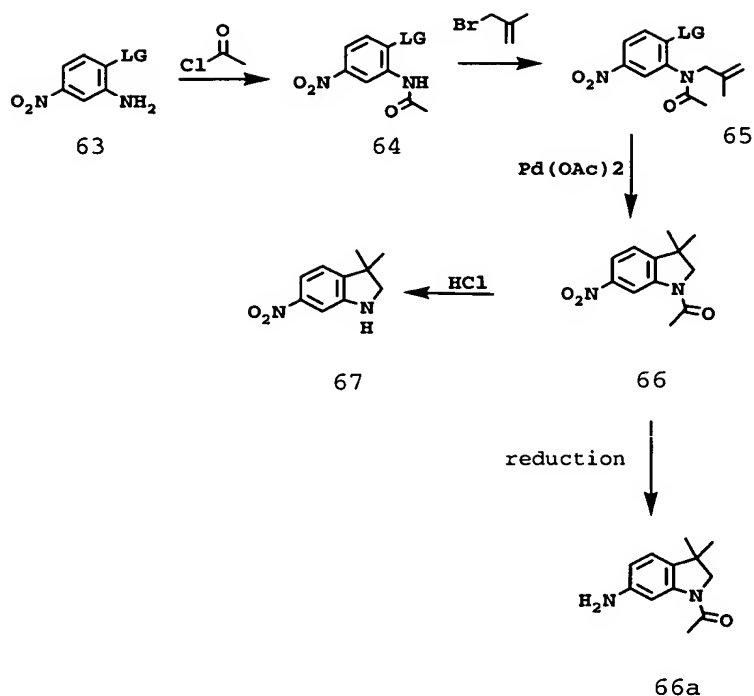
Substituted indolines are prepared such as by the procedures described in Scheme 20. Substituted amino-indolines **59** are prepared from the nitroindoline **57** and a ketone in the presence of  $\text{NaHB(OAc)}_3$  to form the 1-substituted indoline **58**. The nitroindoline **58** is hydrogenated, such as with  $\text{H}_2$  in the presence of a catalyst, such as  $\text{Pd/C}$ , to yield the amino-indoline **59**.

Alternatively, substituted amino-indolines **62** are prepared from the nitroindoline **57**. Nitroindoline **57**, is reacted with an acid chloride to form an amide. Further treatment with a primary or secondary amine, preferably a secondary amine, such as in the presence of  $\text{NaI}$ , at a temperature above about  $50^\circ\text{C}$ , and preferably at about  $70^\circ\text{C}$  yields the nitroindoline **60**. The nitro compound **60** is hydrogenated, such as with  $\text{H}_2$  in the presence of a catalyst, such as  $\text{Pd/C}$ , to yield the amino-indoline **61**. The carbonyl is reduced, such as with  $\text{BH}_3\text{-THF}$ , to yield 1-aminoalkyl-indolines **62**.

20

20070909 0400

Scheme 21

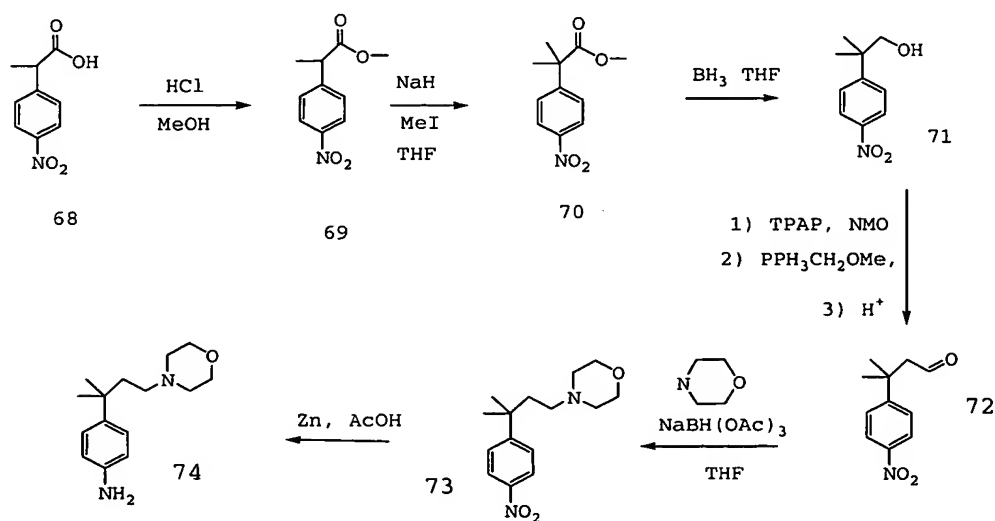


5

Substituted indolines are prepared such as by the procedures described in Scheme 21. Substituted acetamides **64** are prepared from the coupling of halo-5-nitroanilines **63** (where LG is bromo or chloro, preferably chloro) and an acylating agent, such as acetyl chloride, under standard coupling chemistry, such as with DIEA, and DMAP, at a temperature of about RT, in a suitable solvent, such as  $\text{CH}_2\text{Cl}_2$ , DMF and/or DMAC. The N-(2-methylprop-2-enyl)acetamide **65** is prepared from the acetamide **64**, such as by the treatment of base, such as NaH in a suitable solvent such as NMP or anhydrous DMF and a 3-halo-2-methylpropene such as 3-bromo-2-methylpropene or 3-chloro-2-methylpropene, at a temperature between about  $0^\circ\text{C}$  and RT, and preferably at about RT; or with  $\text{CsCO}_3$  at a temperature above RT, preferably above about  $50^\circ\text{C}$  and more preferably above about  $60^\circ\text{C}$ . Cyclization of the N-(2-methylprop-2-enyl)acetamide

65, such as by the Heck-type reaction (treatment with  $\text{Pd}(\text{OAc})_2$  in the presence of base, for example tetraethylammonium chloride, sodium formate, and  $\text{NaOAc}$ ) at a temperature above about  $50^\circ\text{C}$ , and preferably at about  $80^\circ\text{C}$ , yields the protected (3,3-dimethyl-2,3-dihydro-indol-1-yl)ethanone 66. Deprotection, such as with strong acid such as  $\text{AcOH}$ , or  $\text{HCl}$  at a temperature above about  $50^\circ\text{C}$ , and preferably at about  $70$ - $80^\circ\text{C}$ , yields the 3,3-dimethyl-6-nitro-2,3-dihydro-indol-1-yl 67. Alternatively, the protected dihydro-6-nitro indoline 66 can be reduced, such as with  $\text{Fe}$ , or with 10%  $\text{Pd/C}$  in the presence of an excess of  $\text{NH}_4\text{CO}_2\text{H}$ , or with  $\text{H}_2$  in the presence of a catalyst to form the protected dihydro-6-amino indoline 66a.

Scheme 22

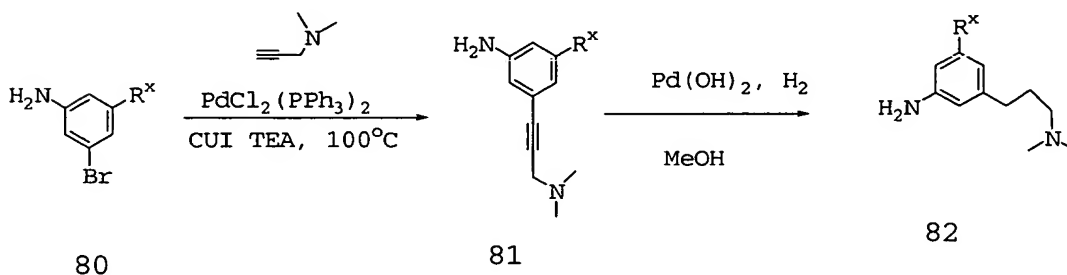


Substituted anilines are prepared such as by the procedures described in Scheme 22. Nitrophenyl esters 69 are formed from the acid 68, such as by treatment with  $\text{MeOH}$  and acid. Alkylation of the ester 69, such as by treatment with base, such as  $\text{NaH}$ , followed by alkyl halide, yields the branched alkyl compounds 70. Reduction of the ester 70,

such as with  $\text{BH}_3$ , yields the alcohol **71**. The aldehyde **72** is prepared from the alcohol **71**, such as by treatment with TPAP in the presence of N-methylmorpholine-N-oxide. Subsequent treatment with methoxymethyltriphenylphosphonium chloride and KHMDS yields **72**. Coupling of the aldehyde **72** with morpholine, such as with  $\text{NaBH}(\text{OAc})_3$ , yields the tertiary amine **73**. Reduction of the nitro compound, such as with acid, for example  $\text{AcOH}$ , and zinc yields the aniline **74**.

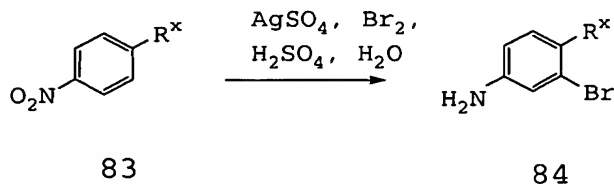
10

Scheme 23



Substituted aniline compounds (where  $\text{R}^x$  is a substituent selected those available for substituted  $\text{R}^2$ , preferably haloalkyl and alkyl) are prepared such as by the procedure described in Scheme 23. Alkynyl-aniline **81**, prepared similar to that described in Scheme 23, is hydrogenated such as with  $\text{H}_2$  in the presence of a catalyst, such as  $\text{Pd}(\text{OH})_2$ , to yield the substituted alkyl **82**.

Scheme 24



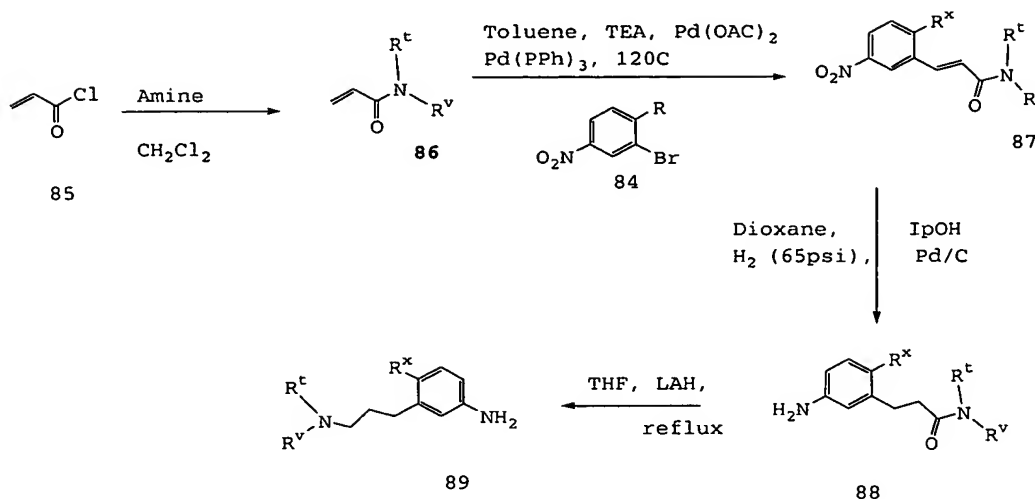
25

Substituted bromophenyl compounds are prepared such as by the procedure described in Scheme 24. Bromine is added

to a optionally substituted nitrobenzene **83**, AgSO<sub>4</sub> and acid, such as H<sub>2</sub>SO<sub>4</sub>, to provide the bromo derivative **84**.

Scheme 25

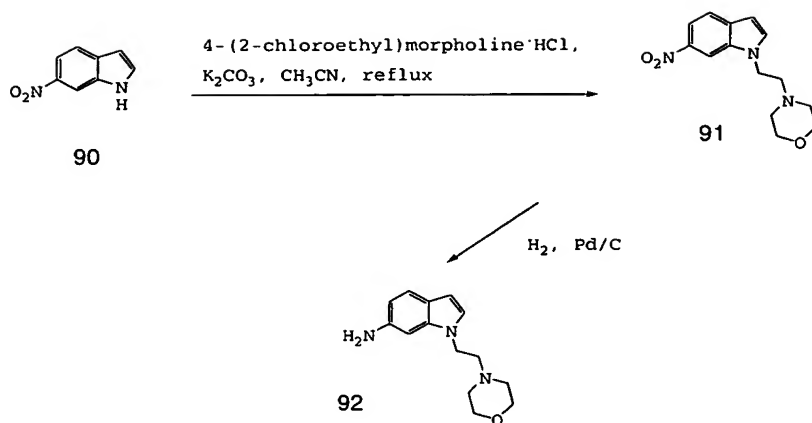
5



Substituted anilines are prepared such as by the procedure described in Scheme 25 (where R<sup>t</sup> and R<sup>v</sup> are alkyl, or together with the nitrogen atom form a 4-6 membered heterocyclic ring). Acryloyl chloride **85** is reacted with an amine, preferably a secondary amine, such as at a temperature between about 0°C and about RT, to form the amide **86**. A bromo-nitrobenzene **84** is reacted with the amide **88**, such as in the presence of base, for example TEA, together with Pd(OAc)<sub>2</sub> and Pd(PPh<sub>3</sub>)<sub>4</sub>, at a temperature above about 50°C, and preferably at about 120°C, such as in a sealed container, to form the substituted alkene **87**. Hydrogenation of the alkene **87**, such as with H<sub>2</sub> in the presence of a catalyst, for example Pd/C catalyst yields the substituted aniline **88**. Reduction of the amide **88**, such as with LiAlH<sub>4</sub>, at a temperature above about 50°C, and preferably at about 80°C yields the aniline **89**.

2007-01-01 09:00:00

## Scheme 26

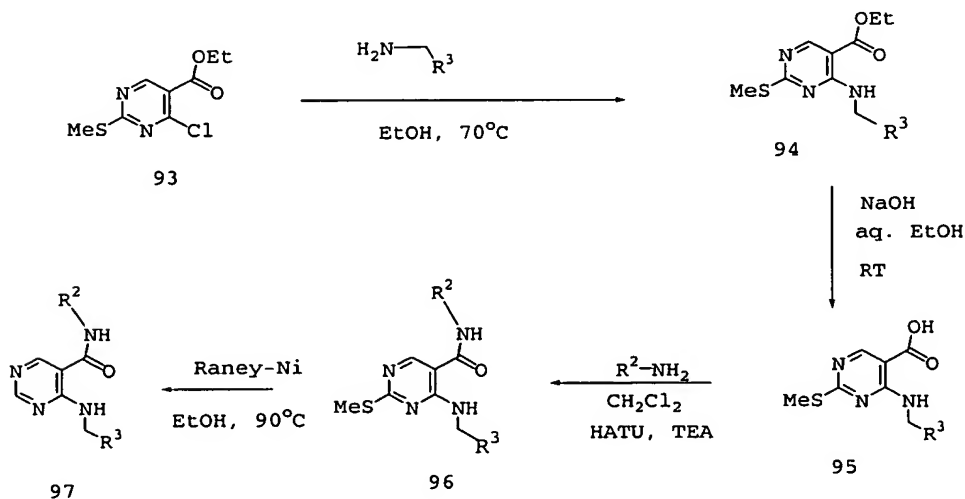


5

Substituted indoles are prepared such as by the procedure described in Scheme 26. A nitroindole **90** is coupled with a halo compound, in the presence of base, for example  $K_2CO_3$ . Heating at a temperature above about  $50^\circ C$ , and preferably at about reflux yields the substituted-nitro-1H-indole **91**. Hydrogenation similar to conditions described above yields the amino derivative **92**.

10

## Scheme 27

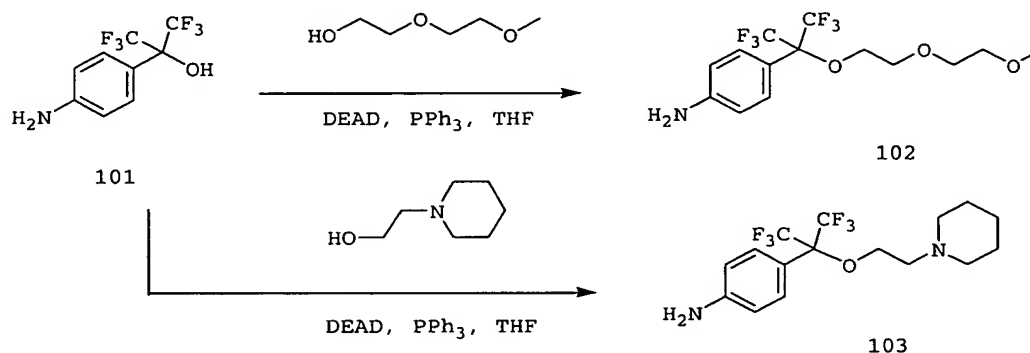




Substituted pyrimidines are prepared such as by the procedure described in Scheme 27. 2-Methylthio-5-pyrimidyl acids **95** are prepared from the corresponding esters **93**

5 similar to procedures described above. The amides **96** are formed from the acids **95** by coupling with the amine such as in the presence of HATU and base, TEA for example. The methylthio group can be removed, such as with Raney-Ni and heat, preferably at about reflux temperature, to form the  
10 pyrimidine **97**.

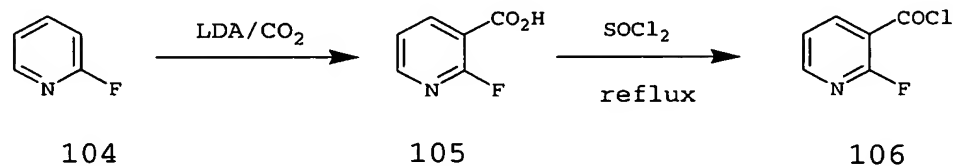
Scheme 28



15 Substituted anilines are prepared such as by the procedure described in Scheme 28. Treatment with the haloalkyl alcohol **101** with an alcohol, such as in the presence of DEAD and PPh<sub>3</sub> yields the ether **102** or **103**.

20

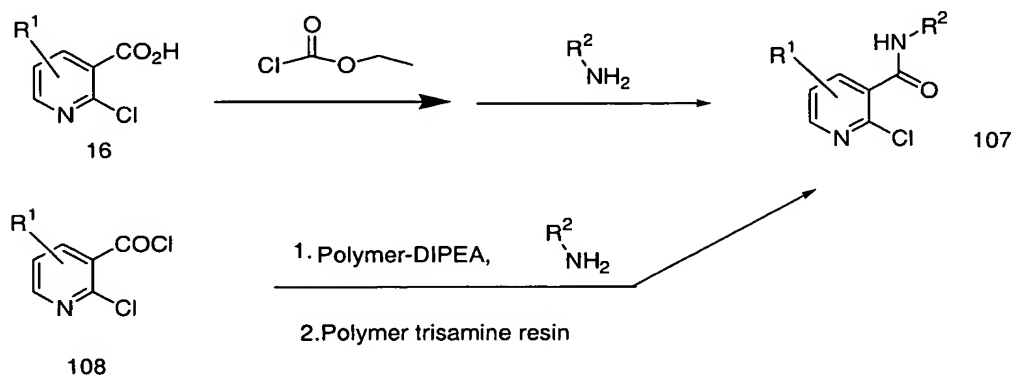
Scheme 29



Functionalized pyridines are prepared such as by the procedure described in Scheme 29. 2-Fluoropyridine **104** is treated with base, such as LDA, at a temperature below about 0°C, and preferably at about -78°C, and quenched with a stream of dry CO<sub>2</sub> to form the nicotinic acid **105**.

Alternatively, solid CO<sub>2</sub> (dry ice) can be used, preferably dried with N<sub>2</sub> prior to use. The acid **105** is converted to the acid halide **106**, such as by treatment with thionyl chloride and heating at a temperature above about 50°C, and preferably at about reflux.

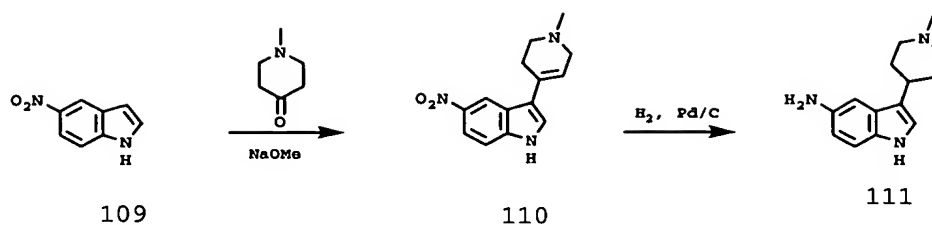
Scheme 30



Chloro-substituted pyridines **107** are prepared such as by the procedure described in Scheme 30. 2-Chloronicotinic acid is activated with ethyl chloroformate, in the presence of base, such as TEA, at a temperature of about RT.

Reaction with an amine produces amide **107**. Alternatively, the amine can be coupled with the acid chloride **108**, such as with polymer-supported DIPEA. Excess acid chloride is removed by treating the reaction mixture with polymer-supported trisamine resin, to form amide **107**.

Scheme 31

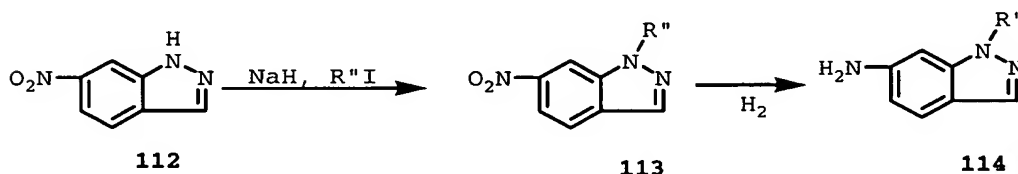


5

Amino-substituted indoles **111** are prepared such as by the procedure described in Scheme 31. Nitroindoline **109** is reacted with N-methyl-4-piperidone in the presence of NaOMe at a temperature above about 50°C, and preferably at about reflux, to form the 3-substituted indole **110**. Hydrogenation as previously discussed yields the amino indole **111**.

10

Scheme 32



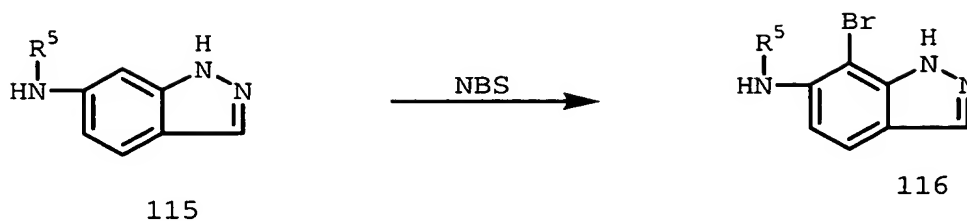
15

Alkylated indazoles can be prepared by the process outlined in Scheme 32. To a solution of 6-nitroindazole **112** in a solvent such as THF is added strong base, such as NaH at a temperature below RT, preferably at about 0°C. Alkylhalides, such as where R'' is methyl, are added and reacted at a temperature about RT to give 1-alkyl-6-nitro-1H-indazole **113**. The nitro indazole **113** is hydrogenated, such as with an H<sub>2</sub> atmosphere in the presence of a catalyst, such as Pd/C to give the 1-substituted-6-amino-1H-indazole **114**.

20

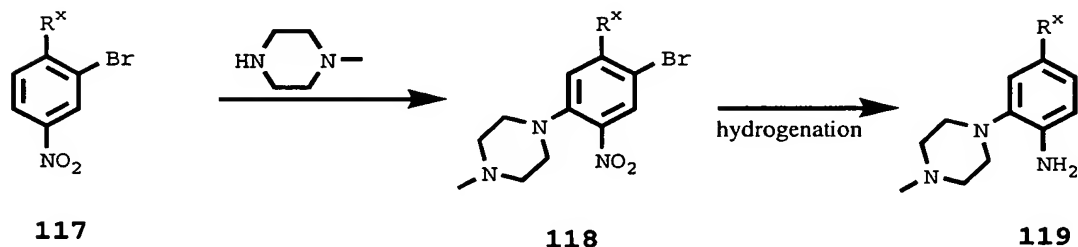
25

## Schem 33



5 Brominated indazoles can be prepared by the process outlined in Scheme 33. NBS is slowly added to an acidic solution, such as a mixture of TFA:H<sub>2</sub>SO<sub>4</sub> (5:1) and *tert*-butyl-4-nitrobenzene 115 at a temperature of about RT to yield the brominated compound 116.

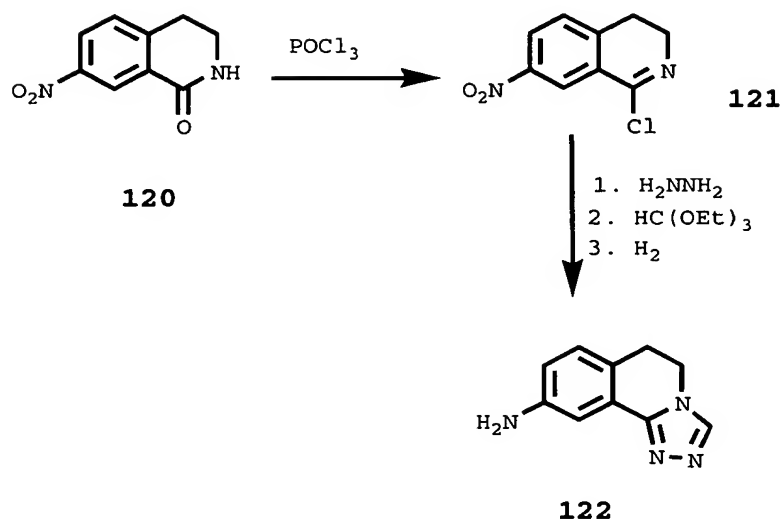
## Scheme 34



15 Substituted anilines (where R<sup>x</sup> is a substituent selected those available for substituted R<sup>2</sup>) can be prepared by the process outlined in Scheme 34. A mixture of 1-(substituted)-2-bromo-4-nitrobenzene 117 and N-methylpiperazine is heated, such as with or without solvent, preferably without solvent, at a temperature above RT, preferably at a temperature above about 100°C, and more preferably at a temperature at about 130°C to give the 1-[5-(substituted)-2-nitrophenyl]-4-methylpiperazine 118. The nitro compound 118 is hydrogenated, such as with an H<sub>2</sub> atmosphere in the presence of a catalyst, such as Pd/C to

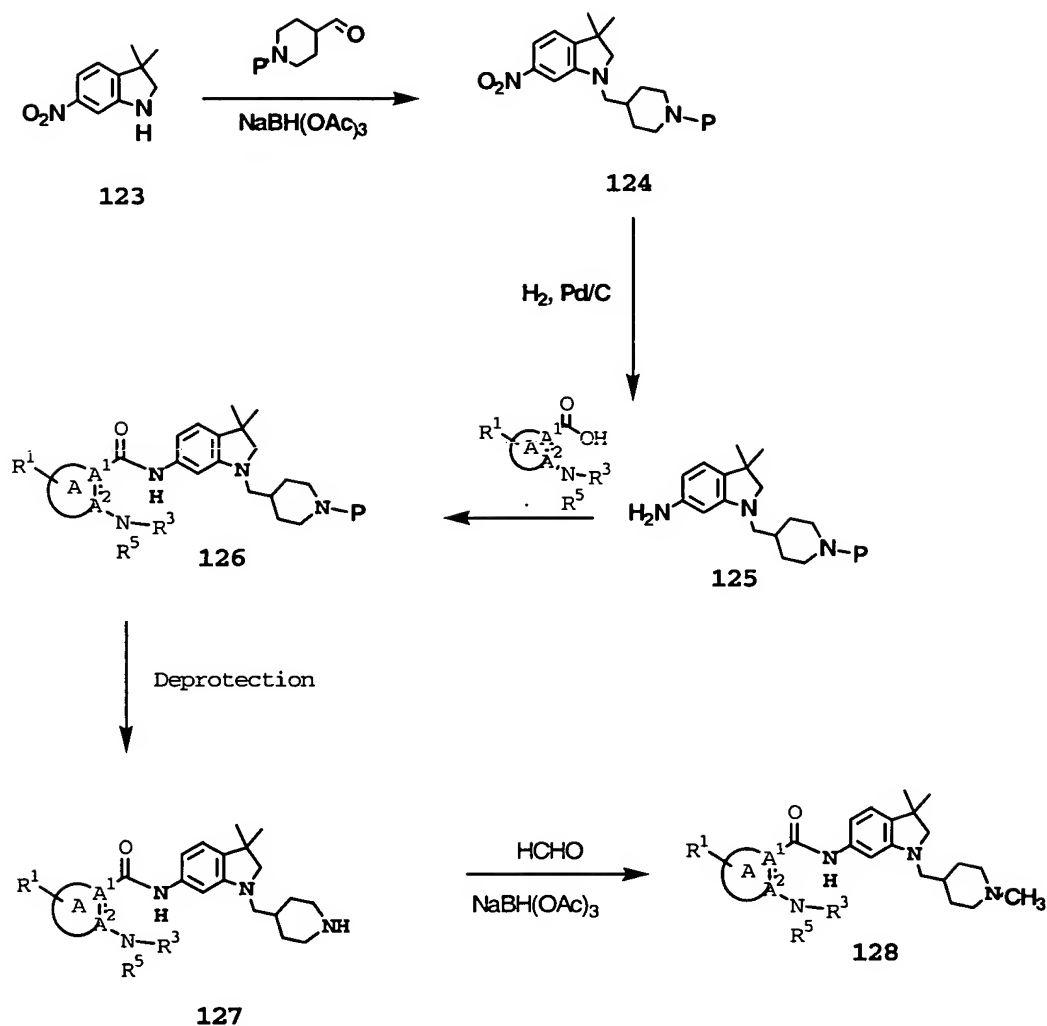
furnish 4-(substituted)-2-(4-methylpiperazinyl)phenylamine  
119.

Scheme 35



Tricyclic heterocycles can be prepared by the process outlined in Scheme 35. 7-Nitro-2,3,4-trihydroisoquinolin-1-one **120** is heated in POCl<sub>3</sub> at a temperature above RT, preferably at a temperature sufficient for reflux, to form the 1-chloro-7-nitro-3,4-dihydroisoquinoline **121**. The 1-chloro-7-nitro-3,4-dihydroisoquinoline **121** is dissolved in a solvent, such as THF, and H<sub>2</sub>NNH<sub>2</sub> is added. The reaction is heated with HC(OEt)<sub>3</sub> at a temperature above RT, preferably at a temperature above about 75°C, and more preferably at a temperature at about 115°C to give the nitro-substituted tricyclic. Hydrogenation, such as with an H<sub>2</sub> atmosphere in the presence of a catalyst, such as Pd/C, gives 2-amino-5,6,7-trihydro-1,2,4-triazolo[3,4-a]isoquinoline **122**.

Scheme 36



5

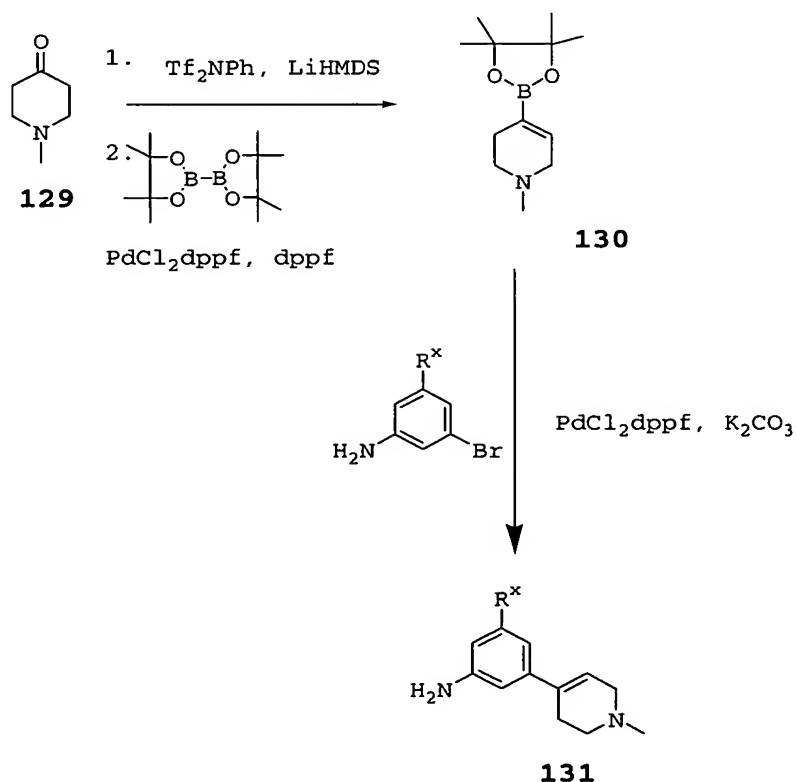
Indolyl substituted carboxamides can be prepared from the corresponding nitro indoline **123** by the process outlined in Scheme 36. For example, 3,3-dimethyl-6-nitroindoline **123** is alkylated, such as with N-protected-4-formylpiperidine in the presence of NaHB(OAc)<sub>3</sub> and acid, such as glacial AcOH, and solvent, such as dichloromethane, at a temperature of about RT, to afford the alkylated indane **124**. Hydrogenation of the alkylated indane **124**, such as

10

with an H<sub>2</sub> atmosphere in the presence of a catalyst, such as Pd/C, in the presence of a solvent, such as an alcohol, preferably MeOH, to give the amino intermediate **125**.

Alternatively, other hydrogenation methods can be used, such as Fe powder with NH<sub>4</sub>Cl. Coupling of the amine **125**, such as with 2-chloronicotinic acid and DIEA, HOBt and EDC, in a solvent such as CH<sub>2</sub>Cl<sub>2</sub> at a temperature of about RT provides the protected carboxamide **126**, which upon deprotection and alkylation yields other compounds of the invention, **127** and **128**, respectively. Alternatively, amine **125** is reacted with 2-fluoronicotinoyl chloride to form a 2-fluoronicotinamide, which can be alkylated, such as in Scheme 10.

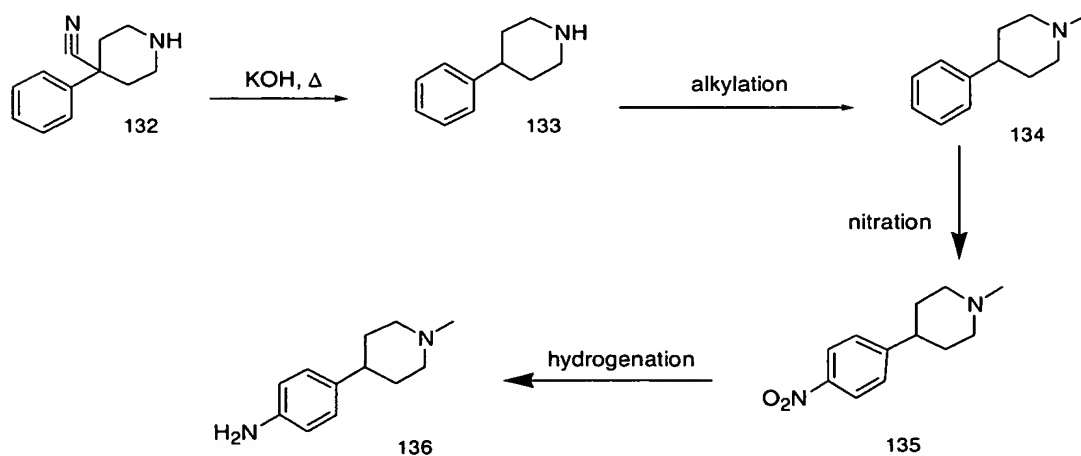
Scheme 37



Substituted anilines can be prepared by the process outlined in Scheme 37 (where R<sup>x</sup> is a substituent selected

those available for substituted  $R^2$ , preferably haloalkyl and alkyl). 1-Methyl-4-piperidinone **129** is added to a solution of strong base such as LiHMDS, in a solvent such as THF, at a temperature below RT, preferably lower than about  $-50^{\circ}\text{C}$ , more preferably at about  $-78^{\circ}\text{C}$ .  $\text{Tf}_2\text{NPh}$  is reacted with the enolate at a temperature of about RT, to give 1-methyl-4-(1,2,5,6-tetrahydro)pyridyl-(trifluoromethyl)sulfonate. A mixture of the triflate intermediate, bis(pinacolato)diboron, potassium acetate,  $\text{PdCl}_2\text{dppf}$ , and dppf in a solvent such as dioxane is heated at a temperature above RT, preferably at a temperature above about  $50^{\circ}\text{C}$ , and more preferably at a temperature at about  $80^{\circ}\text{C}$  to give 4,4,5,5-tetramethyl-2-(1-methyl(4-1,2,5,6-tetrahydropyridyl))-1,3,2-dioxaborolane **130**. The substituted aniline **131** is formed from the 1,3,2-dioxaborolane **130** such as with treatment with an amine in the presence of  $\text{PdCl}_2\text{dppf}$  and base, such as  $\text{K}_2\text{CO}_3$ , in a solvent such as DMF at a temperature above RT, preferably at a temperature above about  $50^{\circ}\text{C}$ , and more preferably at a temperature at about  $80^{\circ}\text{C}$ .

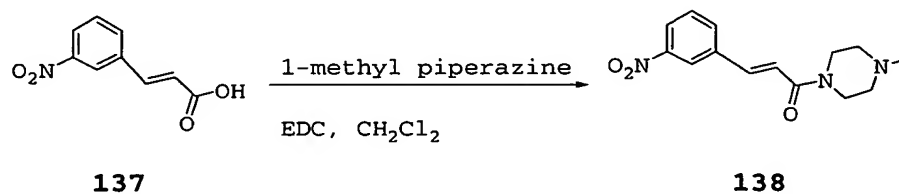
Scheme 38





Substituted anilines can be prepared by the process outlined in Scheme 38. 4-Cyano-4-phenylpiperidine hydrochloride **132** is treated with base, such as KOH, at a temperature above RT, preferably at a temperature above about 100°C, and more preferably at a temperature at about 160°C, to provide the phenyl piperidine **133**. Alkylation of the phenyl piperidine **133**, such as with formaldehyde and NaCNBH<sub>3</sub> in a solvent such as CH<sub>3</sub>CN, with sufficient acid to maintain the reaction pH near 7, to provide the alkylated piperidine **134**. Nitration of the phenylpiperidine **134**, such as with H<sub>2</sub>SO<sub>4</sub> and fuming HNO<sub>3</sub> at a temperature below RT, and preferably at about 0°C, gives the nitro intermediate **135**. Hydrogenation of the nitro intermediate **135**, such as with an H<sub>2</sub> atmosphere in the presence of a catalyst, such as Pd/C, in the presence of a solvent, such as an alcohol, preferably MeOH, to give the amino intermediate **136**.

Scheme 39

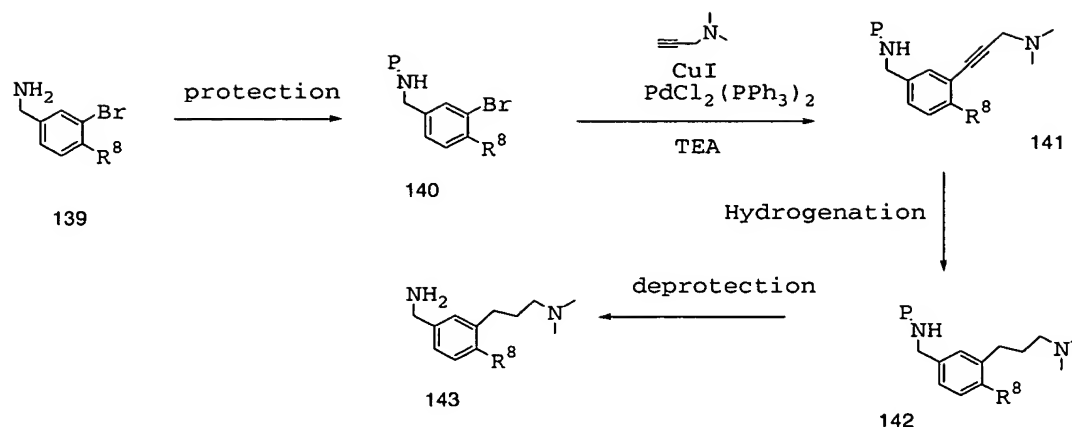


20

Substituted amides can be prepared by the process outlined in Scheme 39. 3-Nitrocinnamic acid **137** is coupled with 1-methylpiperazine in the presence of EDC and a solvent such as CH<sub>2</sub>Cl<sub>2</sub>, at a temperature of about RT gives the carboxamide **138**.

25

Schem 40

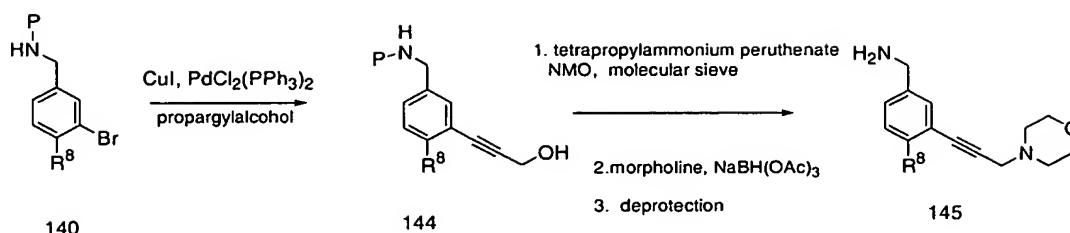


5

Substituted benzylamines can be prepared by the process outlined in Scheme 40. A substituted bromobenzylamine **139** where  $R^{2a}$  is a substituent described for  $R^2$  is protected such as with  $Boc_2O$  in the presence of base, such as  $TEA$  in an appropriate solvent such as  $CH_2Cl_2$ . The protected bromobenzylamine **140** is alkylated, such as with 1-dimethylamino-2-propyne in the presence of catalyst, such as  $PdCl_2(PPh_3)_2$  bis(triphenylphosphino)-palladium chloride, and  $CuI$ , in the presence of base, such as  $TEA$ , at a temperature above  $RT$ , preferably at a temperature above about  $50^\circ C$ , and more preferably at a temperature at about  $100^\circ C$ , such as in a sealed tube, to form the propynylbenzylamine **141**. The propynylbenzylamine is hydrogenated such as with  $H_2$  in the presence of  $Pd(OH)_2$  and  $MeOH$  to provide the propylbenzylamine **142**. Deprotection, such as with strong acid, such as  $TFA$ , for removal of a  $Boc$  protecting group, yields the propylbenzylamine **143**.

20

Scheme 41



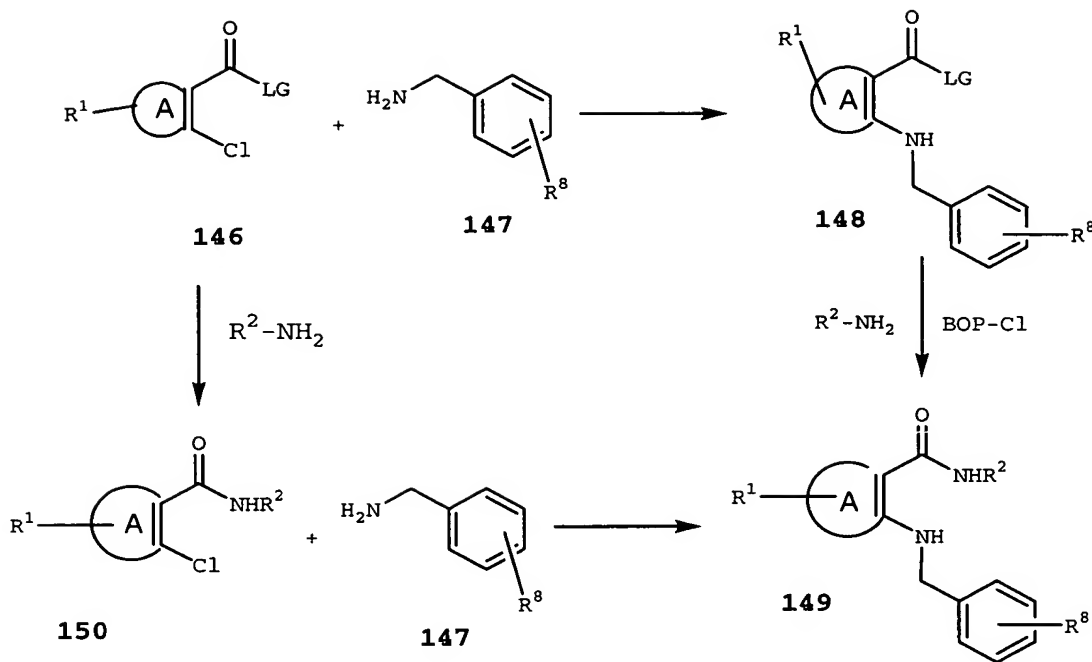
5

Substituted benzylamines can be prepared by the process outlined in Scheme 41. The protected bromobenzylamine **140** is alkylated, such as with propargyl alcohol in the presence of catalyst, such as  $\text{PdCl}_2(\text{PPh}_3)_2$ , and  $\text{CuI}$ , in the presence of base, such as TEA, at a temperature above RT, preferably at a temperature above about  $50^\circ\text{C}$ , and more preferably at a temperature at about  $100^\circ\text{C}$ , such as in a sealed tube, to form the protected hydroxypropynylbenzylamine **144**. The protected hydroxypropynylbenzylamine is treated with N-methylmorpholine oxide in the presence of a catalyst, such as tetrapropylammonium perruthenate, to form the aldehyde intermediate. Reductive amination, such as with the addition of morpholine and  $\text{NaBH}(\text{OAc})_3$ , provides the morpholinyl derivative. Deprotection, such as with strong acid, such as TFA, for removal of a Boc protecting group, yields the propylbenzylamine **145**.

20

2007-03-23 10:00:00

Scheme 42



5

Substituted heterocycles may be prepared by the method found in Scheme 42. Chloro-heterocycles **146** (where LG is OH) is coupled with an amine **147** at a suitable temperature, such as a temperature over about 100°C to give the 2-substituted amino-nicotinic acid **148**. The 2-substituted amino-nicotinic acid **148** is reacted with a substituted amine in the presence of a coupling reagent, such as BOP-Cl and base, such as TEA to form the 2-substituted amino-nicotinamide **149**.

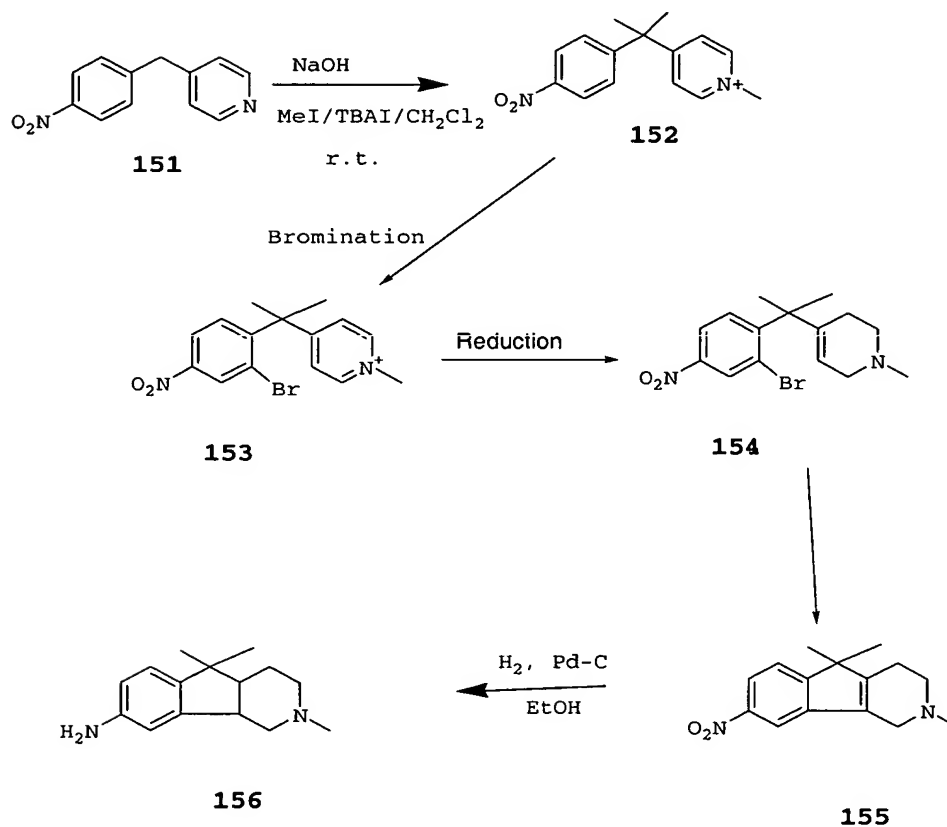
Alternatively, 2-chloro-nicotinoyl chloride **146** (where LG is Cl) is coupled first with R<sup>2</sup>-NH<sub>2</sub>, such as in the presence of base, e.g., NaHCO<sub>3</sub>, in a suitable solvent, such as IpOH or CH<sub>2</sub>Cl<sub>2</sub>, to form the amide **150**, then coupled with a benzylamine **147** to yield the 2-substituted amino-nicotinamide **149**. Where A is a pi-electron rich heterocycle, the addition of KF, such as 40% KF on alumina

20

in IpOH, at a temperature over about 100°C, preferably about 160°C, can be used in the formation of **149** from **150**.

Scheme 43

5



2,3,4,4a,9,9a-hexahydro-1H-3-aza-fluoren-6-ylamine may be prepared by the method found in Scheme 43.

- 10 Nitrobenzylpyridines **151** are alkylated, such as with MeI, in the presence of TBAI and base to form the pyridinium compound **152**. The pyridinium compounds **152** are halogenated, such as brominated with NBS, to form the brominated pyridinium compounds **153** which are reduced such as with
- 15 NaBH<sub>4</sub> to form the tetrahydro-pyridines **154**. Palladium catalyzed intramolecular Heck coupling followed by hydrogenation forms the hexahydro-fluorenes **156**.

The starting compounds defined in Schemes 1-43 may also be present with functional groups in protected form if necessary and/or in the form of salts, provided a salt-forming group is present and the reaction in salt form is possible. If so desired, one compound of Formula I-III can be converted into another compound of Formula I-III or an N-oxide thereof; a compound of Formula I-III can be converted into a salt; a salt of a compound of Formula I-III can be converted into the free compound or another salt; and/or a mixture of isomeric compounds of Formula I-III can be separated into the individual isomers.

N-Oxides can be obtained in a known manner by reacting a compound of Formula I-III with hydrogen peroxide or a peracid, e.g., 3-chloroperoxy-benzoic acid, in an inert solvent, e.g.,  $\text{CH}_2\text{Cl}_2$ , at a temperature between about -10-35°C, such as about 0°C - RT.

If one or more other functional groups, for example carboxy, hydroxy, amino, or mercapto, are or need to be protected in a compound of Formula I-III or in the synthesis of a compound of Formula I-III, because they should not take part in the reaction, these are such groups as are usually used in the synthesis of peptide compounds, and also of cephalosporins and penicillins, as well as nucleic acid derivatives and sugars.

The protecting groups may already be present in precursors and should protect the functional groups concerned against unwanted secondary reactions, such as acylations, etherifications, esterifications, oxidations, solvolysis, and similar reactions. It is a characteristic of protecting groups that they lend themselves readily, i.e. without undesired secondary reactions, to removal, typically by solvolysis, reduction, photolysis or also by enzyme activity, for example under conditions analogous to physiological conditions, and that they are not present in

the end-products. The specialist knows, or can easily establish, which protecting groups are suitable with the reactions mentioned above and hereinafter.

The protection of such functional groups by such  
5 protecting groups, the protecting groups themselves, and  
their removal reactions are described for example in  
standard reference works, such as J. F. W. McOmie,  
"Protective Groups in Organic Chemistry", Plenum Press,  
London and New York 1973, in T. W. Greene, "Protective  
10 Groups in Organic Synthesis", Wiley, New York 1981, in "The  
Peptides"; Volume 3 (editors: E. Gross and J. Meienhofer),  
Academic Press, London and New York 1981, in "Methoden der  
organischen Chemie" (Methods of organic chemistry), Houben  
Weyl, 4th edition, Volume 15/1, Georg Thieme Verlag,  
15 Stuttgart 1974, in H.-D. Jakubke and H. Jescheit,  
"Aminosäuren, Peptide, Proteine" (Amino acids, peptides,  
proteins), Verlag Chemie, Weinheim, Deerfield Beach, and  
Basel 1982, and in Jochen Lehmann, "Chemie der  
Kohlenhydrate: Monosaccharide und Derivate" (Chemistry of  
20 carbohydrates: monosaccharides and derivatives), Georg  
Thieme Verlag, Stuttgart 1974.

In the additional process steps, carried out as  
desired, functional groups of the starting compounds which  
should not take part in the reaction may be present in  
25 unprotected form or may be protected for example by one or  
more of the protecting groups mentioned above under  
"protecting groups". The protecting groups are then wholly  
or partly removed according to one of the methods described  
there.

30 Salts of a compound of Formula I-III with a salt-  
forming group may be prepared in a manner known *per se*. Acid  
addition salts of compounds of Formula I-III may thus be  
obtained by treatment with an acid or with a suitable anion  
exchange reagent. A salt with two acid molecules (for

example a dihalogenide of a compound of formula I) may also be converted into a salt with one acid molecule per compound (for example a monohalogenide); this may be done by heating to a melt, or for example by heating as a solid under a high vacuum at elevated temperature, for example from about 130°C to about 170°C, one molecule of the acid being expelled per molecule of a compound of Formula I-III.

Salts can usually be converted to free compounds, e.g., by treating with suitable basic agents, for example with alkali metal carbonates, alkali metal hydrogen carbonates, or alkali metal hydroxides, typically potassium carbonate or sodium hydroxide.

A compound of formula I, wherein Z is oxygen, can be converted into the respective compound wherein Z is sulfur, for example, by using an appropriate sulfur compound, e. g. using reaction with Lawesson's reagent (2,4-bis-(4-methoxyphenyl)-1,3-dithia-2,4-diphosphetane-2,4-disulfide) in a halogenated hydrocarbon, such as  $\text{CH}_2\text{Cl}_2$ , or an aprotic solvent, such as toluene or xylene, at temperatures from about 30°C to reflux.

All process steps described here can be carried out under known reaction conditions, preferably under those specifically mentioned, in the absence of or usually in the presence of solvents or diluents, preferably such as are inert to the reagents used and able to dissolve these, in the absence or presence of catalysts, condensing agents or neutralizing agents, for example ion exchangers, typically cation exchangers, for example in the  $\text{H}^+$  form, depending on the type of reaction and/or reactants at reduced, normal, or elevated temperature, for example in the range from about -100°C to about 190°C, preferably from about -80°C to about 150°C, for example at about -80 to about 60°C, at RT, at about -20°C to about 40°C or at the boiling point of the solvent used, under atmospheric pressure or in a closed



vessel, where appropriate under pressure, and/or in an inert atmosphere, for example under argon or nitrogen.

Salts may be present in all starting compounds and transients, if these contain salt-forming groups. Salts may  
5 also be present during the reaction of such compounds, provided the reaction is not thereby disturbed.

In certain cases, typically in hydrogenation processes, it is possible to achieve stereoselective reactions, allowing for example easier recovery of  
10 individual isomers.

The solvents from which those can be selected which are suitable for the reaction in question include for example water, esters, typically lower alkyl-lower alkanates, e.g., ethyl acetate, ethers, typically aliphatic  
15 ethers, e.g., diethyl ether, or cyclic ethers, e.g., THF, liquid aromatic hydrocarbons, typically benzene or toluene, alcohols, typically MeOH, EtOH or 1-propanol, IpOH, nitriles, typically CH<sub>3</sub>CN, halogenated hydrocarbons, typically CH<sub>2</sub>Cl<sub>2</sub>, acid amides, typically DMF, bases,  
20 typically heterocyclic nitrogen bases, e.g. pyridine, carboxylic acids, typically lower alkanecarboxylic acids, e.g., AcOH, carboxylic acid anhydrides, typically lower alkane acid anhydrides, e.g., acetic anhydride, cyclic, linear, or branched hydrocarbons, typically cyclohexane,  
25 hexane, or isopentane, or mixtures of these solvents, e.g., aqueous solutions, unless otherwise stated in the description of the process. Such solvent mixtures may also be used in processing, for example in chromatography.

The invention relates also to those forms of the  
30 process in which one starts from a compound obtainable at any stage as a transient and carries out the missing steps, or breaks off the process at any stage, or forms a starting material under the reaction conditions, or uses said starting material in the form of a reactive derivative or

salt, or produces a compound obtainable by means of the process according to the invention and processes the said compound *in situ*. In the preferred embodiment, one starts from those starting materials which lead to the compounds  
5 described above as preferred.

The compounds of Formula I-III, including their salts, are also obtainable in the form of hydrates, or their crystals can include for example the solvent used for crystallization (present as solvates).

10 New starting materials and/or intermediates, as well as processes for the preparation thereof, are likewise the subject of this invention. In the preferred embodiment, such starting materials are used and reaction conditions so selected as to enable the preferred compounds to be  
15 obtained.

Starting materials of the invention, are known, are commercially available, or can be synthesized in analogy to or according to methods that are known in the art.

For example, amine 1 can be prepared by reduction of  
20 the corresponding nitro. The reduction preferably takes place in the presence of a suitable reducing agent, such as tin(II) chloride or hydrogen in the presence of an appropriate catalyst, such as Raney nickel (then preferably the hydrogen is used under pressure, e.g. between 2 and 20  
25 bar) or PtO<sub>2</sub>, in an appropriate solvent, e.g. an alcohol, such as MeOH. The reaction temperature is preferably between about 0°C and about 80°C, especially about 15°C to about 30°C.

It would also be possible to reduce the nitro compound  
30 after forming the amide compound under reaction conditions analogous to those for the reduction of nitro compounds described above. This would eliminate the need to protect the free amino group as described in Scheme 1.

In the preparation of starting materials, existing functional groups which do not participate in the reaction should, if necessary, be protected. Preferred protecting groups, their introduction and their removal are described  
5 above or in the examples.

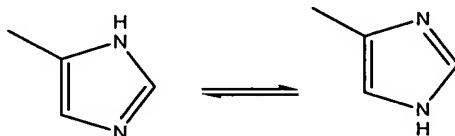
All remaining starting materials are known, capable of being prepared according to known processes, or commercially obtainable; in particular, they can be prepared using processes as described in the examples.

10 Compounds of the present invention can possess, in general, one or more asymmetric carbon atoms and are thus capable of existing in the form of optical isomers as well as in the form of racemic or non-racemic mixtures thereof. The optical isomers can be obtained by resolution of the  
15 racemic mixtures according to conventional processes, e.g., by formation of diastereoisomeric salts, by treatment with an optically active acid or base. Examples of appropriate acids are tartaric, diacetyltartaric, dibenzoyltartaric, ditoluoyltartaric, and camphorsulfonic acid and then  
20 separation of the mixture of diastereoisomers by crystallization followed by liberation of the optically active bases from these salts. A different process for separation of optical isomers involves the use of a chiral chromatography column optimally chosen to maximize the  
25 separation of the enantiomers. Still another available method involves synthesis of covalent diastereoisomeric molecules by reacting compounds of the invention with an optically pure acid in an activated form or an optically pure isocyanate. The synthesized diastereoisomers can be  
30 separated by conventional means such as chromatography, distillation, crystallization or sublimation, and then hydrolyzed to deliver the enantiomerically pure compound. The optically active compounds of the invention can likewise be obtained by using optically active starting

materials. These isomers may be in the form of a free acid, a free base, an ester or a salt.

The compounds of this invention may contain one or more asymmetric centers and thus occur as racemates and  
5 racemic mixtures, scalemic mixtures, single enantiomers, individual diastereomers and diastereomeric mixtures. All such isomeric forms of these compounds are expressly included in the present invention.

The compounds of this invention may also be  
10 represented in multiple tautomeric forms, for example, as illustrated below:



15 The invention expressly includes all tautomeric forms of the compounds described herein.

The compounds may also occur in cis- or trans- or E- or Z- double bond isomeric forms. All such isomeric forms of such compounds are expressly included in the present  
20 invention. All crystal forms of the compounds described herein are expressly included in the present invention.

Substituents on ring moieties (e.g., phenyl, thienyl, etc.) may be attached to specific atoms, whereby they are intended to be fixed to that atom, or they may be drawn  
25 unattached to a specific atom, whereby they are intended to be attached at any available atom that is not already substituted by an atom other than H (hydrogen).

The compounds of this invention may contain heterocyclic ring systems attached to another ring system.  
30 Such heterocyclic ring systems may be attached through a carbon atom or a heteroatom in the ring system.

Alternatively, a compound of any of the formulas delineated herein may be synthesized according to any of the processes delineated herein. In the processes delineated herein, the steps may be performed in an alternate order and may be preceded, or followed, by additional protection/deprotection steps as necessary. The processes may further comprise use of appropriate reaction conditions, including inert solvents, additional reagents, such as bases (e.g., LDA, DIEA, pyridine, K<sub>2</sub>CO<sub>3</sub>, and the like), catalysts, and salt forms of the above. The intermediates may be isolated or carried on *in situ*, with or without purification. Purification methods are known in the art and include, for example, crystallization, chromatography (liquid and gas phase, simulated moving bed ("SMB")), extraction, distillation, trituration, reverse phase HPLC and the like. Reactions conditions such as temperature, duration, pressure, and atmosphere (inert gas, ambient) are known in the art and may be adjusted as appropriate for the reaction.

As can be appreciated by the skilled artisan, the above synthetic schemes are not intended to comprise a comprehensive list of all means by which the compounds described and claimed in this application may be synthesized. Further methods will be evident to those of ordinary skill in the art. Additionally, the various synthetic steps described above may be performed in an alternate sequence or order to give the desired compounds. Synthetic chemistry transformations and protecting group methodologies (protection and deprotection) useful in synthesizing the inhibitor compounds described herein are known in the art and include, for example, those such as described in R. Larock, *Comprehensive Organic Transformations*, VCH Publishers (1989); T.W. Greene and P.G.M. Wuts, *Protective Groups in Organic Synthesis*, 3rd.

Ed., John Wiley and Sons (1999); L. Fieser and M. Fieser, *Fieser and Fieser's Reagents for Organic Synthesis*, John Wiley and Sons (1994); A. Katritzky and A. Pozharski, *Handbook of Heterocyclic Chemistry*, 2<sup>nd</sup> Ed. (2001); M.

- 5 Bodanszky, A. Bodanszky: *The practice of Peptide Synthesis* Springer-Verlag, Berlin Heidelberg 1984; J. Seyden-Penne: *Reductions by the Alumino- and Borohydrides in Organic Synthesis*, 2<sup>nd</sup> Ed., Wiley-VCH, 1997; and L. Paquette, ed., *Encyclopedia of Reagents for Organic Synthesis*, John Wiley  
10 and Sons (1995).

The compounds of this invention may be modified by appending appropriate functionalities to enhance selective biological properties. Such modifications are known in the art and include those which increase biological penetration  
15 into a given biological compartment (e.g., blood, lymphatic system, central nervous system), increase oral availability, increase solubility to allow administration by injection, alter metabolism and alter rate of excretion.

The following examples contain detailed descriptions  
20 of the methods of preparation of compounds of Formulas I-III. These detailed descriptions fall within the scope, and serve to exemplify, the above described General Synthetic Procedures which form part of the invention. These detailed descriptions are presented for illustrative purposes only  
25 and are not intended as a restriction on the scope of the invention.

Unless otherwise noted, all materials were obtained from commercial suppliers and used without further purification. Anhydrous solvents such as DMF, THF, CH<sub>2</sub>Cl<sub>2</sub> and toluene were  
30 obtained from the Aldrich Chemical Company. All reactions involving air- or moisture-sensitive compounds were performed under a nitrogen atmosphere. Flash chromatography was performed using Aldrich Chemical Company silica gel (200-400 mesh, 60A) or Biotage pre-packed column. Thin-

layer chromatography (TLC) was performed with Analtech gel TLC plates (250  $\mu$ ). Preparative TLC was performed with Analtech silica gel plates (1000-2000  $\mu$ ). Preparative HPLC was conducted on Beckman or Waters HPLC system with 0.1% TFA/H<sub>2</sub>O and 0.1% TFA/CH<sub>3</sub>CN as mobile phase. The flow rate was at 20 ml/min. and gradient method was used. <sup>1</sup>H NMR spectra were determined with super conducting FT NMR spectrometers operating at 400 MHz or a Varian 300 MHz instrument. Chemical shifts are expressed in ppm downfield from internal standard tetramethylsilane. All compounds showed NMR spectra consistent with their assigned structures. Mass spectra (MS) were determined on a Perkin Elmer - SCIEX API 165 electrospray mass spectrometer(positive and, or negative) or an HP 1100 MSD LC-MS with eletrospray ionization and quadrupole detection. All parts are by weight and temperatures are in Degrees centigrade unless otherwise indicated.

The following abbreviations are used:

	AIBN -	2,2'-azobisisobutyronitrile
	Ar -	argon
5	AgSO <sub>4</sub> -	silver sulfate
	ATP -	adenosine triphosphate
	BH <sub>3</sub> -	borane
	Boc -	tert-butyloxycarbonyl
	Boc <sub>2</sub> O -	Boc anhydride
10	BOP-Cl -	bis(2-oxo-3-oxazolidinyl)phosphinic chloride
	Br <sub>2</sub> -	bromine
	BSA -	bovine serum albumin
	t-BuOH -	tert-butanol
15	CAN -	ammonium cerium(IV) nitrate
	CH <sub>3</sub> CN, AcCN -	acetonitrile
	CH <sub>2</sub> Cl <sub>2</sub> -	dichloromethane
	CH <sub>3</sub> I, MeI -	iodomethane, methyl iodide
	CCl <sub>4</sub> -	carbon tetrachloride
20	CCl <sub>3</sub> -	chloroform
	CO <sub>2</sub> -	carbon dioxide
	Cs <sub>2</sub> CO <sub>3</sub> -	cesium carbonate
	DIEA -	diisopropylethylamine
	CuI -	copper iodide
25	DCE -	1,2-dichloroethane
	DEAD -	diethyl azodicarboxylate
	DIEA -	diisopropylethylamine
	dppf -	1,1-diphenylphosphinoferrocene
	DMAP -	4-(dimethylamino)pyridine
30	DMAC -	N,N-dimethylacetamide
	DMF -	dimethylformamide
	DMSO -	dimethylsulfoxide
	DTT -	dithiothreitol
	EDC, EDAC-	1-(3-dimethylaminopropyl)-3-



		ethylcarbodiimide hydrochloride
	EGTA -	ethylene glycol-bis( $\beta$ -aminoethyl ether)- N,N,N',N'-tetraacetic acid
	EtOAc -	ethyl acetate
5	EtOH -	ethanol
	Et <sub>2</sub> O -	diethyl ether
	Fe -	iron
	g -	gram
	h -	hour
10	HATU -	O-(7-azabenzotriazol-1-yl)-N,N,N',N'- tetramethyluronium hexafluorophosphate
	H <sub>2</sub> -	hydrogen
	H <sub>2</sub> O -	water
	HCl -	hydrochloric acid
15	H <sub>2</sub> SO <sub>4</sub> -	sulfuric acid
	H <sub>2</sub> NNH <sub>2</sub> -	hydrazine
	HC(OEt) <sub>3</sub> -	triethylorthoformate
	HCHO, H <sub>2</sub> CO -	formaldehyde
	HCO <sub>2</sub> Na -	sodium formate
20	HOAc, AcOH -	acetic acid
	HOAt -	1-hydroxy-7-azabenzotriazole
	HOBT -	hydroxybenzotriazole
	IpOH -	isopropanol
	K <sub>2</sub> CO <sub>3</sub> -	potassium carbonate
25	KHMDS -	potassium hexamethylsilazane
	KNO <sub>3</sub> -	potassium nitrate
	KOAc -	potassium acetate
	KOH -	potassium hydroxide
	LAH, LiAlH <sub>4</sub> -	lithium aluminum hydride
30	LDA -	lithium diisopropylamide
	LiCl -	lithium chloride
	LiHMDS -	lithium hexamethyldisilazide
	MeOH -	methanol
	MgCl <sub>2</sub> -	magnesium chloride

	MgSO <sub>4</sub> -	magnesium sulfate
	mg -	milligram
	ml -	milliliter
	MnCl <sub>2</sub> -	manganese chloride
5	NBS -	N-bromosuccinimide
	NMO -	4-methylmorpholine, N-oxide
	NMP -	N-methylpyrrolidone
	Na <sub>2</sub> SO <sub>4</sub> -	sodium sulfate
	Na <sub>2</sub> S <sub>2</sub> O <sub>5</sub> -	sodium metabisulfite
10	NaHCO <sub>3</sub> -	sodium bicarbonate
	Na <sub>2</sub> CO <sub>3</sub> -	sodium carbonate
	NaCl -	sodium chloride
	NaH -	sodium hydride
	NaI -	sodium iodide
15	NaOH -	sodium hydroxide
	NaOMe -	sodium methoxide
	NaCNBH <sub>3</sub> -	sodium cyanoborohydride
	NaBH <sub>4</sub> -	sodium borohydride
	NaNO <sub>2</sub> -	sodium nitrate
20	NaBH(OAc) <sub>3</sub> -	sodium triacetoxymborohydride
	NH <sub>4</sub> Cl -	ammonium chloride
	N <sub>2</sub> -	nitrogen
	Pd/C -	palladium on carbon
	PdCl <sub>2</sub> (PPh <sub>3</sub> ) <sub>2</sub> -	palladium chloride bis(triphenylphosphine)
25	PdCl <sub>2</sub> (dppf) -	1,1-bis(diphenylphosphino)ferrocene palladium chloride
	Pd(PPh <sub>3</sub> ) <sub>4</sub> -	palladium tetrakis triphenylphosphine
	Pd(OH) <sub>2</sub> -	palladium hydroxide
	Pd(OAc) <sub>2</sub> -	palladium acetate
30	PMB -	para methoxybenzyl
	POCl <sub>3</sub> -	phosphorus oxychloride
	PPh <sub>3</sub> -	triphenylphosphine
	PtO <sub>2</sub> -	platinum oxide
	RT -	room temperature

	SiO <sub>2</sub> -	silica
	SOCl <sub>2</sub> -	thionyl chloride
	TBAI -	tetrabutylammonium iodide
	TEA -	triethylamine
5	Tf <sub>2</sub> NPh -	N-phenyltrifluoromethanesulfonimide
	TFA -	trifluoroacetic acid
	THF -	tetrahydrofuran
	TPAP -	tetrapropylammoniumperruthenate
	Tris-HCl -	Tris(hydroxymethyl)aminomethane
10		hydrochloride salt
	Zn -	zinc

**Preparation I - 3-nitro-5-trifluoromethyl-phenol**

1-Methoxy-3-nitro-5-trifluoromethyl-benzene (10g, Aldrich)  
15 and pyridine-HCl (41.8g, Aldrich) were mixed together and  
heated neat at 210°C in an open flask. After 2.5 h the  
mixture was cooled to RT and partitioned between 1N HCl and  
EtOAc. The EtOAc fraction was washed with 1N HCl (4x), brine  
(1x), dried with Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo  
20 to form 3-nitro-5-trifluoromethyl-phenol as an off-white  
solid.

**Preparation II - 1-Boc-4-(3-nitro-5-trifluoromethyl-  
phenoxy)-piperidine**

25 3-Nitro-5-trifluoromethyl-phenol (8.81g) was dissolved in  
THF (76 ml). 1-Boc-4-hydroxy-piperidine (8.81 g, Aldrich)  
and Ph<sub>3</sub>P (11.15 g) were added and the solution was cooled to  
-20°C. A solution of DEAD (6.8 ml, Aldrich) in THF (36 ml)  
was added dropwise, maintaining the temperature between -20  
30 and -10°C. The reaction was warmed to RT and stirred  
overnight. The reaction was concentrated in vacuo and  
trituated with hexane. The yellow solid was removed by  
filtration and washed with Et<sub>2</sub>O (25 ml), and hexane. The  
white filtrate was washed with 1N NaOH (2x), brine (1x) and

the hexane layer was dried over  $\text{Na}_2\text{SO}_4$ , filtered and concentrated in vacuo. The crude material was purified with flash chromatography ( $\text{SiO}_2$ , 5-10% EtOAc/hexane) to obtain 1-Boc-4-(3-nitro-5-trifluoromethyl-phenoxy)-piperidine.

5

The following compounds were prepared similarly to the procedure outlined above:

- 10 a) (S)-1-Boc-[2-(5-nitro-2-trifluoromethylphenoxy)methyl]-pyrrolidine  
b) (R)-1-Boc-[2-(5-nitro-2-trifluoromethylphenoxy)methyl]-pyrrolidine.  
c) (R) 1-Boc-2-(3-Nitro-5-trifluoromethyl-phenoxy)methyl)-pyrrolidine  
15 d) 4-(2-tert-Butyl-5-nitro-phenoxy)methyl)-1-methyl-piperidine.  
e) (S) 1-Boc-2-(3-Nitro-5-trifluoromethyl-phenoxy)methyl)-pyrrolidine  
f) 1-Boc-3-(5-nitro-2-pentafluoroethyl-phenoxy)methyl)-  
20 azetidine.  
g) N-Boc-[2-(5-nitro-2-pentafluoroethyl-phenoxy)-ethyl]amine.  
h) (R) 3-(2-tert-Butyl-5-nitro-phenoxy)methyl)-1-Boc-pyrrolidine.  
25 i) 3-(2-tert-Butyl-5-nitro-phenoxy)methyl)-1-Boc-azetidine.  
j) (S)-1-Boc-[2-(5-nitro-2-tert-butylphenoxy)methyl]-pyrrolidine  
k) (S) 3-(2-tert-Butyl-5-nitro-phenoxy)methyl)-1-Boc-pyrrolidine.  
30 l) (R)-1-Boc-[2-(5-nitro-2-tert-butylphenoxy)methyl]-pyrrolidine

**Preparation III - 1-Boc-4-(3-amino-5-trifluoromethyl-  
phenoxy)-piperidine**

1-Boc-4-(3-nitro-5-trifluoromethyl-phenoxy)-piperidine (470 mg) was dissolved in MeOH (12 ml) and Pd/C (10 mg) was added. After sparging briefly with H<sub>2</sub>, the mixture was stirred under H<sub>2</sub> for 6 H. The catalyst was removed by filtration and the MeOH solution was concentrated in vacuo to yield 1-Boc-4-(3-amino-5-trifluoromethyl-phenoxy)-piperidine as an off-white foam.

The following compounds were prepared similarly to the procedure outlined above:

- a) 1-Boc-2-(3-Amino-5-trifluoromethyl-phenoxy)methyl)-pyrrolidine.
- b) 2-(3-Amino-5-trifluoromethyl-phenoxy)methyl)-1-methyl-pyrrolidine.
- c) [2-(1-Methylpiperidin-4-yloxy)-pyridin-4-yl]methylamine. ESI (M+H)=222.
- d) [2-(2-Morpholin-4-yl-ethoxy)-pyridin-4-yl]methylamine.
- e) [2-(2-Morpholin-4-yl-propoxy)-pyridin-4-yl]methylamine.
- f) [2-(1-Methyl-pyrrolidin-2-ylmethoxy)-pyridin-4-yl]methylamine. ESI MS: (M+H)=222.
- g) (4-Aminomethyl-pyridin-2-yl)-(3-morpholin-4-yl-propyl)-amine. ESI MS: (M+H)=251.
- h) 4-tert-Butyl-3-(1-methyl-piperidin-4-ylmethoxy)-phenylamine.
- i) 4-tert-Butyl-3-(2-piperidin-1-yl-ethoxy)-phenylamine.
- j) 3-(1-Methyl-piperidin-4-ylmethoxy)-4-pentafluoroethyl-phenylamine.
- k) 3-(1-Isopropyl-piperidin-4-ylmethoxy)-4-pentafluoroethyl-phenylamine.
- l) (S) 3-Oxiranylmethoxy-4-pentafluoroethyl-phenylamine.

- m) 3-(2-Pyrrolidin-1-yl-ethoxy)-4-trifluoromethyl-phenylamine.
- n) 3-(2-Piperidin-1-yl-ethoxy)-4-trifluoromethyl-phenylamine.
- 5 o) (S) 3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenylamine.
- p) (R) 3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenylamine.
- q) (R) 3-(1-Methyl-pyrrolidin-2-ylmethoxy)-5-
- 10 trifluoromethyl-phenylamine.
- r) (S) 3-(1-Methyl-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenylamine
- s) (R) 3-Oxiranylmethoxy-4-pentafluoroethyl-phenylamine.
- t) (R) 2-(5-Amino-2-pentafluoroethyl-phenoxy)-1-pyrrolidin-
- 15 1-yl-ethanol.
- u) 3-(1-Boc-azetidin-3-ylmethoxy)-4-pentafluoroethyl-phenylamine.
- v) 3-(2-(Boc-amino)ethoxy)-4-pentafluoroethyl-phenylamine.
- w) 6-Amino-2,2-dimethyl-4H-benzo[1,4]oxazin-3-one. M+H
- 20 193.2. Calc'd 192.1.
- x) 2,2,4-Trimethyl-3,4-dihydro-2H-benzo[1,4]oxazin-6-ylamine.
- y) 1-(6-Amino-2,2-dimethyl-2,3-dihydro-benzo[1,4]oxazin-4-yl)-ethanone. M+H 221.4. Calc'd 220.3.
- 25 z) [2-(1-Benzhydryl-azetidin-3-yloxy)-pyridin-4-yl]-methylaniline.
- aa) [2-(1-Methyl-piperidin-4-ylmethoxy)-pyridin-4-yl]-methylaniline. M+H 236.3. Calc'd 235.2.
- ab) 3-(4-Boc-piperazin-1-ylmethyl)-5-trifluoromethyl-
- 30 phenylamine. M+H 360.3.
- ac) 2-Boc-4,4-dimethyl-1,2,3,4-tetrahydro-isoquinolin-7-ylamine.
- ad) 3-Morpholin-4-ylmethyl-4-pentafluoroethyl-phenylamine.

- ae) 3-(4-Methyl-piperazin-1-ylmethyl)-4-pentafluoroethyl-phenylamine. M+H 410.3. Calc'd 409.4.
- af) 7-Amino-2-(4-methoxy-benzyl)-4,4-dimethyl-3,4-dihydro-2H-isoquinolin-1-one. M+H 311.1.
- 5 ag) 7-Amino-4,4-dimethyl-3,4-dihydro-2H-isoquinolin-1-one.
- ah) (3-Amino-5-trifluoromethyl-phenyl)-(4-Boc-piperazin-1-yl)-methanone. M+H 374.3; Calc'd 373.
- ai) 3-(4-Boc-Piperazin-1-ylmethyl)-5-trifluoromethyl-phenylamine.
- 10 aj) 1-(7-Amino-4,4-dimethyl-3,4-dihydro-1H-isoquinolin-2-yl)-ethanone. M+H 219.2.
- ak) {2-[2-(1-Methylpiperidin-4-yl)ethoxy]-pyridin-4-yl}-methylamine.
- al) {2-[2-(1-Pyrrolidinyl)ethoxy]-pyridin-4-yl}-methylamine.
- 15 am) {2-[2-(1-Methylpyrrolin-2-yl)ethoxy]-pyridin-4-yl}-methylamine.
- an) (2-Chloro-pyrimidin-4-yl)-methylamine.
- ao) 3-(1-Boc-azetidin-3-ylmethoxy)-5-trifluoromethyl-phenylamine.
- 20 ap) 4-tert-Butyl-3-(1-Boc-pyrrolidin-3-ylmethoxy)-phenylamine. M+H 385.
- aq) 4-tert-Butyl-3-(1-Boc-azetidin-3-ylmethoxy)-phenylamine. M+Na 357.
- ar) (S) 4-tert-Butyl-3-(1-Boc-pyrrolidin-2-ylmethoxy)-phenylamine. M+Na 371.
- 25 as) 3-tert-Butyl-4-(4-Boc-piperazin-1-yl)-phenylamine
- at) 3-(1-Methyl-piperidin-4-yl)-5-trifluoromethyl-phenylamine.
- au) 3,3-Dimethyl-2,3-dihydro-benzofuran-6-ylamine.
- 30 av) 3,9,9-Trimethyl-2,3,4,4a,9,9a-hexahydro-1H-3-azafluoren-6-ylamine.
- aw) 4-[1-Methyl-1-(1-methyl-piperidin-4-yl)-ethyl]-phenylamine was prepared using EtOH as the solvent.

- ax) 4-tert-Butyl-3-(4-pyrrolidin-1-yl-but-1-enyl)-phenylamine.
- ay) (R) 3-(1-Boc-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenylamine.
- 5 az) (S) 3-(1-Boc-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenylamine.

**Preparation IV - 1-Boc-4-{3-[(2-fluoro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy}-piperidine**

- 10 1-Boc-4-(3-amino-5-trifluoromethyl-phenoxy)-piperidine (4.37 g) was dissolved in CH<sub>2</sub>Cl<sub>2</sub> (100 ml) and NaHCO<sub>3</sub> (2.4 g, Baker) was added. 2-Fluoropyridine-3-carbonyl chloride (2.12 g) was added and the reaction was stirred at RT for 2.5 h. The reaction was filtered and concentrated in vacuo to yield a
- 15 yellow foam. (30%) EtOAc/Hexane was added and 1-Boc-4-{3-[(2-fluoro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy}-piperidine precipitated as an off white solid.

- The following compounds were prepared similarly to the
- 20 procedure outlined above:

- a) 2-Fluoro-N-[3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-nicotinamide.
- b) N-[4-tert-Butyl-3-(2-piperidin-1-yl-ethoxy)-phenyl]-2-fluoro-nicotinamide.
- 25 c) N-[3,3-Dimethyl-1-(1-methyl-piperidin-4-ylmethyl)-2,3-dihydro-1H-indol-6-yl]-2-fluoro-nicotinamide.
- d) N-[1-(2-Dimethylamino-acetyl)-3,3-dimethyl-2,3-dihydro-1H-indol-6-yl]-2-fluoro-nicotinamide
- 30 e) N-[3,3-Dimethyl-1-(2-(Boc-amino)acetyl)-2,3-dihydro-1H-indol-6-yl]-2-fluoro-nicotinamide.
- f) N-(4-Acetyl-2,2-dimethyl-3,4-dihydro-2H-benzo[1,4]oxazin-6-yl)-2-fluoro-nicotinamide. M+H 344.5. Calc'd 343.4.



- g) 2-Fluoro-N-(2,2,4-trimethyl-3,4-dihydro-2H-benzo[1,4]oxazin-6-yl)-nicotinamide. M+H 316.2. Calc'd 315.1.
- 5 h) N-(2,2-Dimethyl-3-oxo-3,4-dihydro-2H-benzo[1,4]oxazin-6-yl)-2-fluoro-nicotinamide. M+H 316.1. Calc'd 315.10.
- i) 2-Fluoro-N-[3-(4-methyl-piperazin-1-ylmethyl)-5-trifluoromethyl-phenyl]-nicotinamide. M+H 481. Calc'd 480.
- 10 j) 2-Fluoro-N-(2-Boc-4,4-dimethyl-1,2,3,4-tetrahydro-isoquinolin-7-yl)-nicotinamide. M+H 400.
- k) 2-Fluoro-N-[3-(4-methyl-piperazin-1-ylmethyl)-4-pentafluoroethyl-phenyl]-nicotinamide. M+H 447.0. Calc'd 446.
- 15 l) 2-Fluoro-N-(3-morpholin-4-ylmethyl-4-pentafluoroethyl-phenyl)-nicotinamide.
- m) 2-Fluoro-N-[4-iodophenyl]-nicotinamide.
- n) 2-Fluoro-N-(4,4-dimethyl-1-oxo-1,2,3,4-tetrahydro-isoquinolin-7-yl)-nicotinamide. M+H 314.0, Calc'd 311.
- 20 o) 2-Fluoro-N-[3-(4-Boc-piperazine-1-carbonyl)-5-trifluoromethyl-phenyl]-nicotinamide. M+H 495.
- p) 2-Fluoro-N-[3-(4-Boc-piperazin-1-ylmethyl)-5-trifluoromethyl-phenyl]-nicotinamide. M+H 483.3; Calc'd 482.
- 25 q) N-(2-Acetyl-4,4-dimethyl-1,2,3,4-tetrahydro-isoquinolin-7-yl)-2-fluoro-nicotinamide. M+H 430.0.
- r) N-[3,3-Dimethyl-1-(1-methyl-piperidin-4-yl)-2,3-dihydro-1H-indol-6-yl]-2-fluoro-nicotinamide. M+H 383.2; Calc'd 382.5.
- s) N-(4-tert-Butylphenyl)-2-fluoronicotinamide.
- 30 t) N-(4-Trifluoromethylphenyl)-2-fluoronicotinamide.
- u) 2-Fluoro-N-[3-(1-Boc-azetidin-3-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide. M-H 468.2; Calc'd 469.16.

- v) 2-Fluoro-N-[3-(1-Boc-azetidin-3-ylmethoxy)-4-tert-butyl-phenyl]-nicotinamide.
- w) (S) N-[4-tert-Butyl-3-(1-Boc-pyrrolidin-2-ylmethoxy)-phenyl]-2-fluoro-nicotinamide. M+Na 494.
- 5 x) N-[3-(1-Methyl-piperidin-4-yl)-5-trifluoromethyl-phenyl]-2-fluoro-nicotinamide was prepared with K<sub>2</sub>CO<sub>3</sub>. instead of NaHCO<sub>3</sub>.
- y) N-(3-Bromo-5-trifluoromethyl-phenyl)-2-fluoro-nicotinamide.
- 10 z) 2-Fluoro-N-(3,9,9-trimethyl-2,3,4,4a,9,9a-hexahydro-1H-3-aza-fluoren-6-yl)-nicotinamide.
- aa) 2-Fluoro-N-{4-[1-methyl-1-(1-methyl-piperidin-4-yl)-ethyl]-phenyl}-nicotinamide
- ab) N-[3,3-Dimethyl-1-(1-Boc-piperidin-4-ylmethyl)-2,3-
- 15 dihydro-1H-indol-6-yl]-2-fluoro-nicotinamide.

**Preparation V - 1-Boc-4-{3-[(2-chloro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy}-piperidine**

- 1-Boc-4-{3-[(2-chloro-pyridine-3-carbonyl)-amino]-5-
- 20 trifluoromethyl-phenoxy}-piperidine was prepared from 1-Boc-4-(3-amino-5-trifluoromethyl-phenoxy)-piperidine and 2-chloropyridine-3-carbonyl chloride by a procedure similar to that described in the preparation of 1-Boc-4-{3-[(2-fluoro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy}-
- 25 piperidine.

The following compounds were prepared similarly to the procedure outlined above:

- 30 a) N-(4-tert-Butyl-3-nitro-phenyl)-2-chloro-nicotinamide.
- b) 2-Chloro-N-[3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-nicotinamide.
- c) 2-Chloro-N-[3-(3-morpholin-4-yl-propyl)-5-trifluoromethyl-phenyl]-nicotinamide.

- d) 2-Chloro-N-[3-(1-methylpiperidin-4-yl)-5-trifluoromethyl-phenyl]-nicotinamide.
- e) 2-Chloro-N-[3-(1-methyl-piperidin-4-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide.
- 5 f) 2-Chloro-N-[3-(1-isopropyl-piperidin-4-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide.
- g) (S) 2-Chloro-N-[4-(oxiranylmethoxy)-3-pentafluoroethyl-phenyl]-nicotinamide.
- h) 2-Chloro-N-[3-(2-pyrrolidin-1-yl-ethoxy)-4-trifluoromethyl-phenyl]-nicotinamide.
- 10 i) 2-Chloro-N-[3-(2-piperidin-1-yl-ethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide.
- j) (R) 2-Chloro-N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide.
- 15 k) (S) 2-Chloro-N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide.
- l) (R) 2-Chloro-N-[3-(1-methyl-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide.
- m) (S) 2-Chloro-N-[3-(1-methyl-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide.
- 20 n) (R) 2-Chloro-N-[4-(oxiranylmethoxy)-3-pentafluoroethyl-phenyl]-nicotinamide.
- o) (R) Acetic acid 2-{5-[(2-chloro-pyridine-3-carbonyl)-amino]-2-pentafluoroethyl-phenoxy}-1-pyrrolidin-1-yl-ethyl ester.
- 25 p) 2-Chloro-N-[3-(4-methyl-piperazin-1-ylmethyl)-5-trifluoromethyl-phenyl]-nicotinamide.
- q) 2-Chloro-N-[2-(4-methoxy-benzyl)-4,4-dimethyl-1-oxo-1,2,3,4-tetrahydro-isoquinolin-7-yl]-nicotinamide. M+H 450.2. Calc'd 449.
- 30 r) 2-Chloro-N-(4,4-dimethyl-1-oxo-1,2,3,4-tetrahydro-isoquinolin-7-yl)-nicotinamide. M+H 330.1, Calc'd 329.
- s) 2-Chloro-N-[3-(4-Boc-piperazin-1-ylmethyl)-5-trifluoromethyl-phenyl]-nicotinamide.

- t) 2-{3-[(2-Chloro-pyridine-3-carbonyl)-amino]-phenyl}-2-methyl-propionic acid methyl ester. M+H 405
- u) N-{4-tert-Butyl-3-[2-(1-Boc-piperidin-4-yl)-ethyl]-phenyl}-2-chloro-nicotinamide. M+Na 524. Calc'd 501.1.
- 5 v) N-[3,3-Dimethyl-1,1-dioxo-2,3-dihydro-1H-benzo[d]isothiazol-6-yl]-2-chloro-nicotinamide.
- w) N-[1,1,4,4-Tetramethyl-1,2,3,4-tetrahydro-naphth-6-yl]-2-chloro-nicotinamide.
- x) 2-Chloro-N-[3,3-dimethyl-2,3-dihydro-benzofuran-6-yl]-2-chloro-nicotinamide.
- 10 y) 2-Chloro-N-[3-(1-Boc-piperidin-4-yloxy)-5-trifluoromethyl-phenyl]-nicotinamide.
- z) 2-Chloro-N-[3-(1-methyl-piperidin-4-ylmethyl)-5-trifluoromethyl-phenyl]-nicotinamide.
- 15 aa) 2-Chloro-N-[3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-nicotinamide.
- ab) N-[4-tert-Butyl-3-(4-pyrrolidin-1-yl-but-1-enyl)-phenyl]-2-chloro-nicotinamide.
- ac) (R) 2-Chloro-N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide.
- 20 ad) (S) 2-Chloro-N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide.

**Preparation VI - 1-Boc-2-{3-[(2-fluoro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy-methyl}-pyrrolidine**

25 1-Boc-2-{3-[(2-Fluoro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy-methyl}-pyrrolidine was prepared from 1-Boc-2-(3-amino-5-trifluoromethyl-phenoxy-methyl)-pyrrolidine by a procedure similar to that described in the

30 preparation of 1-Boc-4-{3-[(2-fluoro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy}-piperidine.

**Preparation VII - 2-(3-nitro-5-trifluoromethyl-phenoxy-methyl)-pyrrolidine**

1-Boc-2-(3-nitro-5-trifluoromethyl-phenoxy-methyl)-pyrrolidine (2.35 g) was dissolved in CH<sub>2</sub>Cl<sub>2</sub> (60 ml) and TFA (20 ml) was added. After stirring for 1 h at RT, the mixture was concentrated in vacuo to yield 2-(3-nitro-5-trifluoromethyl-phenoxy-methyl)-pyrrolidine as an oil that solidified upon standing. The material was used as is without further purification.

The following compounds were prepared similarly to the procedure outlined above:

- a) (4-Aminomethyl-pyrimidin-2-yl)-(3-morpholin-4-yl-propyl)-amine.
- b) (4-Aminomethyl-pyrimidin-2-yl)-[2-(1-methyl-pyrrolidin-2-yl)-ethyl]-amine.

**Preparation VIII - 1-methyl-2-(3-nitro-5-trifluoromethyl-phenoxy-methyl)-pyrrolidine**

2-(3-Nitro-5-trifluoromethyl-phenoxy-methyl)-pyrrolidine (6 mmol) was dissolved in CH<sub>3</sub>CN (20 ml) and formaldehyde (2.4 ml, 37% aqueous) was added. NaBH<sub>3</sub>CN (607 mg) was added, an exotherm was observed. The pH is monitored every 15 min and adjusted to ~7 with AcOH. After 45 min, the mixture was concentrated in vacuo and the residue is dissolved in EtOAc, washed with 6N NaOH, 1N NaOH, and 2N HCl (3x). The acid washings were combined, adjusted to ~pH 10 with solid Na<sub>2</sub>CO<sub>3</sub> and extracted with EtOAc (2x). The EtOAc fractions were combined, dried with Na<sub>2</sub>SO<sub>4</sub>, and purified with flash chromatography (SiO<sub>2</sub>, 95:5:0.5 CH<sub>2</sub>Cl<sub>2</sub>:MeOH:NH<sub>4</sub>OH) to afford 1-methyl-2-(3-nitro-5-trifluoromethyl-phenoxy-methyl)-pyrrolidine.

The following compounds were prepared similarly to the procedure outlined above:

- a) 2-(1-Methylpiperidin-4-yl)-ethanol.  
b) 2-{3-[(2-Fluoro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy-methyl}-1-methylpyrrolidine.

5

**Preparation IX - 4-tert-butyl-3-nitro-phenylamine**

A mixture of 1,3-dinitro-4-tert-butylbenzene (10.0 g) in H<sub>2</sub>O (56 ml) was heated to reflux. A mixture of Na<sub>2</sub>S (21.42 g) and sulfur (2.85 g) in H<sub>2</sub>O (34 ml) was added over 1 h via an addition funnel. The reaction maintained at reflux for 1.5 h then cooled to RT and extracted with EtOAc. The organic extracts were combined and washed with H<sub>2</sub>O, brine, dried over MgSO<sub>4</sub> and concentrated in vacuo to afford 4-tert-butyl-3-nitro-phenylamine which was used as is without further purification.

15

**Preparation X - N-(3-bromo-5-trifluoromethyl-phenyl)-acetamide**

3-Bromo-5-(trifluoromethyl)phenylamine (5 g, Alfa-Aesar) was dissolved in AcOH (140 ml) and Ac<sub>2</sub>O (5.9 ml, Aldrich) was added. The reaction was stirred at RT overnight. The mixture was added slowly to H<sub>2</sub>O (~700 ml) forming a white precipitate. The solid was isolated by filtration, washed with H<sub>2</sub>O and dried under vacuum to yield N-(3-bromo-5-trifluoromethyl-phenyl)-acetamide.

25

**Preparation XI - N-[3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide**

Allylpiperidine (1.96 g, Lancaster) was degassed under vacuum, dissolved in 0.5 M 9-BBN in THF (31.2 ml, Aldrich), and heated to reflux for 1 h, then cooled to RT. PD(dppf)Cl<sub>2</sub>/CH<sub>2</sub>Cl<sub>2</sub> was added to a degassed mixture of N-(3-bromo-5-trifluoromethyl-phenyl)-acetamide, K<sub>2</sub>CO<sub>3</sub> (9.8 g) DMF (32.1 ml and H<sub>2</sub>O (3 ml). The allyl piperidine solution was

30

2025 RELEASE UNDER E.O. 14176

added heated to 60°C for 3 h. After cooling to RT and reheating at 60°C for 6 h, the mixture was cooled to RT and poured into H<sub>2</sub>O. The mixture was extracted with EtOAc (2x), and the EtOAc portion was washed with 2 N HCl (2x) and  
5 brine. The aqueous phases were combined and the pH was adjusted to ~11 with NaOH (15%) forming a cloudy suspension. The cloudy suspension was extracted with EtOAc (2x) and the EtOAc portion was dried with Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo. The crude material was purified by  
10 flash chromatography (SiO<sub>2</sub>, 95:5:0.5 CH<sub>2</sub>Cl<sub>2</sub>:MeOH:NH<sub>4</sub>OH) to afford N-[3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide as a brown oil that solidified under vacuum.

15 The following compounds were prepared similarly to the procedure outlined above:

a) N-(3-Morpholin-4-ylpropyl-5-trifluoromethyl-phenyl)-acetamide from 4-allyl-morpholine.

20 b) N-(3-(1-methylpiperidin-4-ylmethyl-5-trifluoromethyl-phenyl)-acetamide from 1-Methyl-4-methylene-piperidine.

**Preparation XII - 3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenylamine**

25 N-[3-(3-Piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide (1.33 g) was dissolved in EtOH (40 ml) and 12 N HCl (40 ml) was added. After stirring overnight at 70°C and RT, the mixture was concentrated in vacuo, affording 3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenylamine as a  
30 brown oil.

The following compounds were prepared similarly to the procedure outlined above:

a) 3,3-Dimethyl-6-nitro-2,3-dihydro-1H-indole. M+H 193.1;  
Calc'd 192.2.

b) 3-(1-Methyl-piperidin-4-ylmethyl)-5-trifluoromethyl-phenylamine.

5 c) 3-Morpholin-4-ylmethyl-5-trifluoromethyl-phenylamine.

**Preparation XIII - 3,3-Dimethyl-6-nitro-1-piperidin-4-ylmethyl-2,3-dihydro-1H-indole**

3,3-Dimethyl-1-(1-Boc-piperidin-4-ylmethyl)-6-nitro-2,3-dihydro-1H-indole was dissolved in HCl/EtOAc and stirred for  
10 2 h. The mixture was concentrated in vacuo and partitioned between 1,2-dichloroethane and 1N NaOH. The organic layer was removed, washed with brine, dried (Na<sub>2</sub>SO<sub>4</sub>) and filtered. The material was used without further purification.

15

**Preparation XIV - N-[3-(3-morpholin-4-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide**

N-[3-(3-Morpholin-4-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide was prepared from allyl morpholine and N-(3-bromo-5-trifluoromethyl-phenyl)-acetamide similar to that  
20 described in the preparation of N-[3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide.

**Preparation XV - 3-(3-morpholin-4-yl-propyl)-5-trifluoromethyl-phenylamine**

3-(3-Morpholin-4-yl-propyl)-5-trifluoromethyl-phenylamine was prepared from N-[3-(3-morpholin-4-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide similar to that described in the preparation of 3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenylamine.  
30

**Preparation XVI - 1-methyl-4-methylene-piperidine**

Ph<sub>3</sub>PCH<sub>3</sub>I (50 g, Aldrich) was suspended in Et<sub>2</sub>O (20 ml) and butyllithium (77.3 ml, 1.6 M in hexanes, Aldrich) was added



dropwise. The reaction was stirred for 2 h at RT then 1-methylpiperidone (12.3 ml, Aldrich) was added slowly. The mixture was stirred at RT overnight. The solid was removed by filtration, the volume was reduced to ~400 ml and

5 additional solid was removed by filtration. The Et<sub>2</sub>O was washed with H<sub>2</sub>O (2x) and 2N HCl (4x). The pH of the acid washings was adjusted to ~11 with 6 N NaOH, then they were extracted with CH<sub>2</sub>Cl<sub>2</sub> (4x). The CH<sub>2</sub>Cl<sub>2</sub> washings were dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated cold in vacuo to provide 1-  
10 methyl-4-methylene-piperidine which was used as is.

**Preparation XVII - N-[3-(1-methylpiperidin-4-yl)-5-trifluoromethyl-phenyl]-acetamide**

N-[3-(1-Methylpiperidin-4-yl)-5-trifluoromethyl-phenyl]-  
15 acetamide was prepared from 1-methyl-4-methylene-piperidine and N-(3-bromo-5-trifluoromethyl-phenyl)-acetamide similar to that described in the preparation of N-[3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenyl]-acetamide.

20 **Preparation XVIII - 3-(1-methylpiperidin-4-yl)-5-trifluoromethyl-phenylamine**

3-(1-Methylpiperidin-4-yl)-5-trifluoromethyl-phenylamine was prepared from N-[3-(1-methylpiperidin-4-yl)-5-trifluoromethyl-phenyl]-acetamide similar to the procedure  
25 described in the preparation of 3-(3-piperidin-1-yl-propyl)-5-trifluoromethyl-phenylamine.

**Preparation XIX - 2-(1-methylpiperidin-4-yloxy)-4-pyridylcarbonitrile**

30 4-Hydroxy-1-methylpiperidine (25.4 g) was dissolved in THF (50 ml) in a 100 mL r.b. flask. NaH/mineral oil mixture (9.58 g) was slowly added to the flask and stirred for 20 min. 2-Chloro-4-cyanopyridine was added to the mixture and stirred at RT until completion. Diluted mixture with EtOAc

2025 RELEASE UNDER E.O. 14176

and added H<sub>2</sub>O to quench mixture, then transferred contents to a sep. funnel. The organic phase was collected while the aqueous phase was washed two times with EtOAc. The combined organics were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, then concentrated in vacuo. Then redissolved mixture in CH<sub>2</sub>Cl<sub>2</sub>, 10% HCl (300 ml) was added and the mixture was transferred to sep. funnel. The org. was extracted, while EtOAc along with 300 mL 5N NaOH was added to the sep. funnel. The organic phases were collected, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo affording 2-(1-methylpiperidin-4-yloxy)-4-pyridylcarbonitrile as a brown solid. ESI (M+H) = 218.

The following compounds were prepared similarly to the procedure outlined above:

- a) 2-(1-methylpiperidin-4-ylmethoxy)-4-pyridylcarbonitrile.  
M+H 232.1. Calc'd 231.1.
- b) 2-(1-Benzhydryl-azetidin-3-yloxy)-4-pyridylcarbonitrile.  
M+H 342.2. Calc'd 341.2.
- c) 2-(1-methylpiperidin-4-ylethoxy)-4-pyridylcarbonitrile.
- d) 2-(1-pyrrolidinylethoxy)-4-pyridylcarbonitrile.
- e) 2-(1-methylpyrrolin-2-ylethoxy)-4-pyridylcarbonitrile.
- f) 2-[2-(1-Boc-azetidin-3-yl)-ethoxy]-4-pyridylcarbonitrile.

**Preparation XX - [2-(1-methylpiperidin-4-yloxy)-pyridin-4-yl]methylamine bis hydrochloride**

[2-(1-Methylpiperidin-4-yloxy)-pyridin-4-yl]methylamine was diluted with Et<sub>2</sub>O (50 ml) and 1M HCl/Et<sub>2</sub>O (47 ml) was added. The vessel was swirled until precipitate formed.

**Preparation XXI - 2-(2-morpholin-4-yl-ethoxy)-4-pyridylcarbonitrile**

2-(2-Morpholin-4-yl-ethoxy)-4-pyridylcarbonitrile was prepared from 2-chloro-4-cyanopyridine and 2-morpholin-4-yl-

ethanol by a procedure similar to that described in the preparation of 2-(1-methylpiperidin-4-yloxy)-4-pyridylcarbonitrile. The hydrochloride salt was prepared similar to that described for [2-(1-methylpiperidin-4-yloxy)-pyridin-4-yl]methylaniline bis hydrochloride.

**Preparation XXII - 2-morpholin-4-yl-propanol**

LAH powder (1.6 g) was added to a flask while under N<sub>2</sub> atmosphere, immediately followed by THF (50 ml). The mixture was chilled to 0°C, methyl 2-morpholin-4-yl-propionate (5 g) was added dropwise to the reaction mixture and stirred at 0°C. After 1 h, the mixture was worked up by adding H<sub>2</sub>O (44 mL), 2N NaOH (44 mL), then H<sub>2</sub>O (44 mL, 3x). After 30 min of stirring, the mixture was filtered through Celite® and the organic portion was concentrated *in vacuo* providing 2-morpholin-4-yl-propanol as a colorless oil.

The following compounds were prepared similarly to the procedure outlined above:

a) (1-Methyl-piperidin-4-yl)-methanol. M+H 130.2. Calc'd 129.1.

**Preparation XXIII - 2-(2-morpholin-4-yl-propoxy)-4-pyridylcarbonitrile**

2-(2-Morpholin-4-yl-propoxy)-4-pyridylcarbonitrile was prepared from 2-chloro-4-cyanopyridine and 2-morpholin-4-yl-propanol by a procedure similar to that described in the preparation of 2-(1-methylpiperidin-4-yloxy)-4-pyridylcarbonitrile.

**Preparation XXIV - 2-(1-Methyl-pyrrolidin-2-ylmethoxy)-4-pyridylcarbonitrile**

2-(1-Methyl-pyrrolidin-2-ylmethoxy)-4-pyridylcarbonitrile was prepared from 2-chloro-4-cyanopyridine and 1-methyl-pyrrolidin-2-ylmethanol by a procedure similar to that described in the preparation of 2-(1-methylpiperidin-4-yloxy)-4-pyridylcarbonitrile. ESI MS: (M+H)=218.

**Preparation XXV - 2-(3-morpholin-4-yl-propylamino)-4-pyridylcarbonitrile**

To a flask charged with 2-chloro-4-cyanopyridine (2.0 g), was added the aminopropyl morpholine (2.11 ml). The mixture was heated to 79°C for 5 h and stirred. After 5 h the reaction was incomplete. The mixture was then heated at 60°C overnight. The crude compound was purified on silica gel (1-5% MeOH/CH<sub>2</sub>Cl<sub>2</sub> gradient). ESI MS: (M+H)=247, (M-H)=245.

**Preparation XXVI - 5-Nitro-2-pentafluoroethylphenol**

Combined 2-methoxy-4-nitro-1-pentafluoroethylbenzene (9.35 g) and pyridine hydrochloride in a round bottom flask and heated at 210°C for 1 h then cooled to RT. The mixture was diluted with EtOAc and 2N HCl (>500 ml) until all residue dissolved. The organic layer was removed, washed with 2N HCl (2x) and concentrated in vacuo. The residue was dissolved in hexanes and Et<sub>2</sub>O, washed with 2N HCl, then brine. Dried organic layer over Na<sub>2</sub>SO<sub>4</sub>, filtered, concentrated in vacuo and dried under high vacuum to provide 5-nitro-2-pentafluoromethylphenol.

**Preparation XXVII - 2-tert-Butyl-5-nitro-aniline**

To H<sub>2</sub>SO<sub>4</sub> (98%, 389 mL) in a 500 mL 3-neck flask was added 2-tert-butyl aniline (40.6 mL). The reaction was cooled to -10°C and KNO<sub>3</sub> in 3.89 g aliquots was added every 6 min for a

total of 10 aliquots. Tried to maintain temperature at  $-5^{\circ}\text{C}$  to  $-10^{\circ}\text{C}$ . After final addition of  $\text{KNO}_3$ , stirred the reaction for five min then it was poured onto ice (50 g).

The black mix was diluted with  $\text{H}_2\text{O}$  and extracted with  $\text{EtOAc}$ .

- 5 The aqueous layer was basified with solid  $\text{NaOH}$  slowly then extracted with  $\text{EtOAc}$  (2x). The combined organic layers were washed with 6N  $\text{NaOH}$  and then with a mix of 6N  $\text{NaOH}$  and brine, dried over  $\text{Na}_2\text{SO}_4$ , filtered and concentrated *in vacuo* to obtain crude 2-tert-butyl-5-nitro-aniline as a dark red-
- 10 black oil which solidified when standing at RT. The crude material was triturated with about 130 mL hexanes. After decanting the hexanes, the material was dried to obtain a dark-red black solid.

15 **Preparation XXVIII - 2-tert-Butyl-5-nitrophenol**

- In a 250 ml round bottom flask, 20 mL concentrated  $\text{H}_2\text{SO}_4$  was added to 2-tert-butyl-5-nitro-aniline (7.15 g) by adding 5 mL aliquots of acid and sonicating with occasional heating until all of the starting aniline went into solution.  $\text{H}_2\text{O}$
- 20 (84 ml) was added with stirring, then the reaction was cooled to  $0^{\circ}\text{C}$  forming a yellow-orange suspension. A solution of  $\text{NaNO}_2$  (2.792 g) in  $\text{H}_2\text{O}$  (11.2 mL) was added dropwise to the suspension and stirred for 5 min. Excess  $\text{NaNO}_2$  was neutralized with urea, then the cloudy solution
- 25 was transferred to 500 ml 3-necked round bottom flask then added 17 mL of 1:2  $\text{H}_2\text{SO}_4$ : $\text{H}_2\text{O}$  solution, and heated at reflux. Two additional 5 mL aliquots of 1:2  $\text{H}_2\text{SO}_4$ : $\text{H}_2\text{O}$  solution, a 7 mL aliquot of 1:2  $\text{H}_2\text{SO}_4$ : $\text{H}_2\text{O}$  solution and another 10 mL of 1:2  $\text{H}_2\text{SO}_4$ :  $\text{H}_2\text{O}$  were added while heating at reflux. The mixture
- 30 was cooled to RT forming a black layer floating on top of the aqueous layer. The black layer was diluted with  $\text{EtOAc}$  (300 mL) and separated. The organic layer was washed with  $\text{H}_2\text{O}$  then brine, dried over  $\text{Na}_2\text{SO}_4$  and concentrated *in vacuo*. Crude oil was purified on silica gel column with 8%

EtOAc/Hexanes. Upon drying under vacuum, the 2-tert-butyl-5-nitrophenol was isolated as a brown solid.

**Preparation XXIX - 1-methylpiperidine-4-carboxylic acid**

**5 ethyl ester**

Piperidine-4-carboxylic acid ethyl ester (78 g) was dissolved in MeOH (1.2 L) at RT then formaldehyde (37%, 90 ml) and acetic acid (42 ml) were added and stirred for 2 h. The mixture was cooled to 0°C, NaCNBH<sub>3</sub> (70 g) was added, and  
10 the mix was stirred for 20 min at 0°C, then overnight at RT. The mixture was cooled to 0°C then quenched with 6N NaOH. The mixture was concentrated *in vacuo* to an aqueous layer, which was extracted with EtOAc (4x), brine-washed, dried over Na<sub>2</sub>SO<sub>4</sub>, and concentrated *in vacuo* to provide 1-  
15 methylpiperidine-4-carboxylic acid ethyl ester.

The following compounds were prepared similarly to the procedure outlined above:

- 20 a) (1-Methyl-piperidin-4-yl)-methanol. M+H 130.2. Calc'd 129.1.

**Preparation XXX - N-[4-tert-Butyl-3-(1-methyl-piperidin-4-ylmethoxy)-phenyl]-2-chloro-nicotinamide**

- 25 N-[4-tert-Butyl-3-(1-methyl-piperidin-4-ylmethoxy)-phenyl]-2-chloro-nicotinamide was prepared from 4-tert-butyl-3-(1-methyl-piperidin-4-ylmethoxy)-phenylamine by a procedure similar to that described in the preparation of 1-Boc-4-{3-[(2-chloro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy}-piperidine.  
30

**Preparation XXXI - 1-[2-(2-tert-Butyl-5-nitro-phenoxy)-ethyl]-piperidine**

To 2-tert-butyl-5-nitrophenol (1.01 g) and  $K_2CO_3$  (1.72 g) was added acetone (35 ml) and  $H_2O$  (10.5 mL), then 1-(2-chloroethyl)piperidine HCl (1.909 g) and TBAI (153 mg). The mixture was stirred at reflux overnight. Additional  $K_2CO_3$  (850 mg) and 1-(2-chloroethyl)-piperidine HCl (950 mg) were added and the mixture was heated at reflux for 6 h. The mixture was concentrated *in vacuo* to an aqueous layer which was acidified with 2N HCl and extracted with EtOAc. The aqueous layer was basified with 6N NaOH and washed with  $CH_2Cl_2$  (3x). The combined organic layers were washed with brine/1N NaOH and dried over  $Na_2SO_4$ . Washed the EtOAc layer with 2N NaOH/brine and dried over  $Na_2SO_4$ . The crude material was purified by silica gel column chromatography with 15% EtOAc/Hexanes to yield 1-[2-(2-tert-butyl-5-nitro-phenoxy)-ethyl]-piperidine as a light tan solid.  $(M+1)=307.3$ .

**20 Preparation XXXII - 1-Boc-Piperidine-4-carboxylic acid ethyl ester**

To a stirred solution of piperidine-4-carboxylic acid ethyl ester (23.5 g) in EtOAc (118 ml) at 0°C was added dropwise  $Boc_2O$  in EtOAc (60 ml). The reaction was warmed to RT and stirred overnight. Washed reaction with  $H_2O$ , 0.1N HCl,  $H_2O$ ,  $NaHCO_3$  and brine. The organic layer was dried over  $Na_2SO_4$ , filtered and concentrated *in vacuo*. The liquid was dried under vacuum to provide 1-Boc-piperidine-4-carboxylic acid ethyl ester.

30

The following compounds were prepared similarly to the procedure outlined above:

a) N-Boc-(2-chloropyrimidin-4-yl)-methylamine.

b) 1-(2-tert-Butyl-4-nitrophenyl)-4-Boc-piperazine.

c) 1-Boc-azetidine-3-carboxylic acid

d) 1-Boc-4-Hydroxymethyl-piperidine using TEA.

5 **Preparation XXXIII - 1-Boc-4-hydroxymethyl-piperidine**

1-Boc-4-Hydroxymethyl-piperidine was prepared from 1-Boc-piperidine-4-carboxylic acid ethyl ester by a procedure similar to that described in the preparation of 2-morpholin-4-yl-propanol.

10

**Preparation XXXIV - 1-Boc-4-Methylsulfonyloxymethyl-piperidine**

Dissolved 1-Boc-4-hydroxymethyl-piperidine in anhydrous  $\text{CH}_2\text{Cl}_2$  (50 ml) and TEA (4.5 ml) and cooled to  $0^\circ\text{C}$ . Mesyl chloride (840  $\mu\text{l}$ ) was added and the mixture was stirred for 15 min then at RT for 45 min. The mixture was washed with brine/1N HCl and then brine, dried over  $\text{Na}_2\text{SO}_4$ , concentrated in vacuo and dried under high vacuum to provide 1-Boc-4-methylsulfonyloxymethyl-piperidine as a yellow orange thick 20 oil.

The following compounds were prepared similarly to the procedure outlined above:

25 a) 1-Boc-3-methylsulfonyloxymethyl-azetidine.

**Preparation XXXV - 1-Boc-4-(3-nitro-6-pentafluoroethyl-phenoxy-methyl)-piperidine**

To a slurry of 60% NaH suspension in DMF (30 mL) at RT added a solution of 5-nitro-2-pentafluoroethyl-phenol (3.6 g) in 5 mL DMF. The dark red mixture was stirred at RT for 10 min then added a solution of 1-Boc-4-methylsulfonyloxymethyl-piperidine (3.1 g) in 5 mL DMF. The reaction was stirred at  $60^\circ\text{C}$  and  $95^\circ\text{C}$ . After 1h, added 2.94 g  $\text{K}_2\text{CO}_3$  and stirred 30



overnight at 105°C. After cooling to RT, the reaction was diluted with hexanes and 1N NaOH. Separated layers, and washed organic layer with 1N NaOH and with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated *in vacuo*. Purification  
5 with silica gel column chromatography with 8% EtOAc/Hexanes yielded 1-Boc-4-(3-nitro-6-pentafluoroethyl-phenoxy-methyl)-piperidine as a light yellow thick oil.

10 **Preparation XXXVI - 4-(3-nitro-6-pentafluoroethyl-phenoxy-methyl)-piperidine**

4-(3-Nitro-6-pentafluoroethyl-phenoxy-methyl)-piperidine was prepared from 1-Boc-4-(3-nitro-6-pentafluoroethyl-phenoxy-methyl)-piperidine by a procedure similar to that described in the preparation of 2-(3-nitro-5-  
15 trifluoromethyl-phenoxy-methyl)-pyrrolidine.

**Preparation XXXVII - 1-methyl-4-(3-nitro-6-pentafluoroethyl-phenoxy-methyl)-piperidine**

4-(3-Nitro-6-pentafluoroethyl-phenoxy-methyl)-piperidine  
20 (316.5 mg) was dissolved in 2.7 mL acetonitrile, then added 37% formaldehyde/H<sub>2</sub>O (360 ul) and then NaBH<sub>3</sub>CN (90 mg). Upon addition of NaCNBH<sub>3</sub> the reaction exothermed slightly. The reaction was stirred at RT and pH was maintained at ~7 by addition of drops of glacial acetic acid. After about 1  
25 h, the mixture was concentrated *in vacuo*, treated with 8 mL 2N KOH and extracted two times with 10 mL Et<sub>2</sub>O. The organic layers were washed with 0.5N KOH and then the combined organic layers were extracted two times with 1N HCl. The aqueous layer was basified with solid KOH and extracted two  
30 times with Et<sub>2</sub>O. This organic layer was then washed with brine/1N NaOH, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, concentrated *in vacuo* and dried under high vacuum to give pure compound.

**Preparation XXXVIII - 1-Isopropyl-4-(5-nitro-2-pentafluoroethyl-phenoxyethyl)-piperidine**

Dissolved 4-(5-nitro-2-pentafluoroethyl-phenoxyethyl)-piperidine (646 mg) in 1,2-dichloroethane (6.4 ml), then  
5 added acetone (136 ul), NaBH(OAc)<sub>3</sub> (541 mg) and finally acetic acid (105 ul). Stirred the cloudy yellow solution under N<sub>2</sub> at RT overnight. Added another 130 uL acetone and stirred at RT over weekend. Quenched the reaction with 30 mL N NaOH/H<sub>2</sub>O and stirred 10 min. Extracted with Et<sub>2</sub>O and  
10 the organic layer was brine-washed, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo. Dried under high vacuum for several h to obtain 1-isopropyl-4-(5-nitro-2-pentafluoroethyl-phenoxyethyl)-piperidine as a yellow orange solid.

15

The following compounds were prepared similarly to the procedure outlined above:

- a) 3,3-Dimethyl-1-(1-methyl-piperidin-4-yl)-6-nitro-2,3-dihydro-1H-indole was prepared using 1-methyl-piperidin-  
20 4-one. M+H 290; Calc'd 289.4.
- b) 3,3-Dimethyl-1-(1-Boc-piperidin-4-ylmethyl)-6-nitro-2,3-dihydro-1H-indole using 1-Boc-4-formyl-piperidine.

**Preparation XXXIX - 3,3-Dimethyl-1-(1-methyl-piperidin-4-ylmethyl)-6-nitro-2,3-dihydro-1H-indole**

25 3,3-Dimethyl-1-piperidin-4-ylmethyl-6-nitro-2,3-dihydro-1H-indole was treated with an excess of formaldehyde and NaBH(OAc)<sub>3</sub> and stirred overnight at RT. The reaction was quenched with MeOH and concentrated in vacuo. The residue  
30 was partitioned between EtOAc and 1N NaOH. The organic layer was removed, washed with brine, dried (Na<sub>2</sub>SO<sub>4</sub>), filtered and concentrated to provide the compound.

**Preparation XL - (S) 2-(5-Nitro-2-pentafluoroethyl-phenoxy-methyl)-oxirane**

Combined 5-nitro-2-pentafluoromethylphenol (2.69 g), DMF (25 ml) K<sub>2</sub>CO<sub>3</sub> (3.03 g) and (S) toluene-4-sulfonic acid oxiranyl-methyl ester (2.27 g) and stirred the mixture at 90°C.

After about 4 hours, the mix was cooled, diluted with EtOAc, washed with H<sub>2</sub>O, 1N NaOH (2x), 1N HCl and then with brine.

Dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated *in vacuo*.

Purified the crude on silica gel column with 5% EtOAc/hexane and drying under high vacuum provided the (S)-2-(5-nitro-2-pentafluoroethyl-phenoxy-methyl)-oxirane.

The following compounds were prepared similarly to the procedure outlined above:

a) (R)-2-(5-Nitro-2-pentafluoroethyl-phenoxy-methyl)-oxirane.

**Preparation XLI - (S) 2-Chloro-N-[3-(2-hydroxy-3-pyrrolidin-1-yl-propoxy)-4-pentafluoroethyl-phenyl]-nicotinamide**

(S) 2-Chloro-N-[4-(2-oxiranylmethoxy)-3-pentafluoroethyl-phenyl]-nicotinamide (1.11 g) in a sealed tube and added pyrrolidine (285 µl). Stirred after sealing tube at 60°C. After 12 h, the mix was concentrated *in vacuo* and purified on a silica gel column (5:95:0.5 MeOH:CH<sub>2</sub>Cl<sub>2</sub>:NH<sub>4</sub>OH - 8:92:1, MeOH:CH<sub>2</sub>Cl<sub>2</sub>:NH<sub>4</sub>OH). Concentrated *in vacuo* and dried under high vacuum to obtain pure compound.

The following compounds were prepared similarly to the procedure outlined above:

a) (R) 1-(5-Nitro-2-pentafluoroethyl-phenoxy)-3-pyrrolidin-1-yl-propan-2-ol.

**Preparation XLII - 5-nitro-2-trifluoromethylanisole**

Cooled 140 mL pyridine in a large sealable vessel to -40°C. Bubbled in trifluoromethyl iodide from a gas cylinder which had been kept in freezer overnight. After adding ICF<sub>3</sub> for 5 20 min, added 2-iodo-5-nitroanisole (24.63 g) and copper powder (67.25 g). Sealed vessel and stirred vigorously for 22 h at 140°C. After cooling to -50°C, carefully unsealed reaction vessel and poured onto ice and Et<sub>2</sub>O. Repeatedly washed with Et<sub>2</sub>O and H<sub>2</sub>O. Allowed the ice - Et<sub>2</sub>O mixture to 10 warm to RT. Separated layers, washed organic layer with 1N HCl (3x), then brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo. Eluted material through silica gel plug (4.5:1 Hex:CH<sub>2</sub>Cl<sub>2</sub>) to provide 5-nitro-2-trifluoromethylanisole.

**Preparation XLIII - 1-[2-(5-nitro-2-trifluoromethylphenoxy)ethyl]pyrrolidine**

1-[2-(5-Nitro-2-trifluoromethylphenoxy)ethyl]-pyrrolidine was prepared from 5-nitro-2-trifluoromethyl-phenol and 1-(2-chloroethyl)pyrrolidine by a procedure similar to that 20 described for 1-[2-(2-tert-butyl-5-nitro-phenoxy)-ethyl]-piperidine.

**Preparation XLIV - 1-[2-(5-Nitro-2-pentafluoroethyl-phenoxy)-ethyl]-piperidine**

1-[2-(5-Nitro-2-pentafluoroethyl-phenoxy)-ethyl]-piperidine was prepared from 5-nitro-2-pentafluoroethylphenol and 1-(2-chloroethyl)piperidine by a procedure similar to that described in the preparation of 1-[2-(2-tert-butyl-5-nitro-phenoxy)-ethyl]-piperidine. 30

**Preparation XLV - 3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenylamine**

3-(2-Pyrrolidin-1-yl-methoxy)-4-trifluoromethyl-phenylamine was prepared from 1-[2-(5-nitro-2-

- 5 trifluoromethylphenoxy)methyl]-pyrrolidine by a procedure similar to that described in the preparation of 1-Boc-4-(3-amino-5-trifluoromethyl-phenoxy)-piperidine.

**Preparation XLVI - 2-Chloro-N-[3-(2-pyrrolidin-1-yl-ethoxy)-4-trifluoromethyl-phenyl]-nicotinamide**

- 10 2-Chloro-N-[3-(2-pyrrolidin-1-yl-ethoxy)-4-trifluoromethyl-phenyl]-nicotinamide was prepared from 3-(2-pyrrolidin-1-yl-ethoxy)-4-trifluoromethyl-phenylamine and 2-chloropyridine-3-carbonyl chloride by a procedure similar to that described
- 15 in the preparation of 1-Boc-4-{3-[(2-chloro-pyridine-3-carbonyl)-amino]-5-trifluoromethyl-phenoxy}-piperidine.

**Preparation XLVII - (R) Acetic acid 2-(5-nitro-2-pentafluoroethyl-phenoxy)-1-pyrrolidin-1-ylmethyl-ethyl ester**

- 20 Dissolved 1-(5-nitro-2-pentafluoroethyl-phenoxy)-3-pyrrolidin-1-yl-propan-2-ol (3.5 g) in  $\text{CH}_2\text{Cl}_2$  (15 ml) , added TEA (2.55 ml) and cooled to  $0^\circ\text{C}$ . Acetyl chloride (781.3  $\mu\text{l}$ ) was added dropwise, forming a suspension. The
- 25 mixture was warmed to RT and stirred for 1.5 h. Additional acetyl chloride (200  $\mu\text{l}$ ) was added and the mix was stirred for another h. The mixture was diluted with  $\text{CH}_2\text{Cl}_2$  and washed with sat.  $\text{NaHCO}_3$ . The organic layer was removed, washed with brine and back extracted with  $\text{CH}_2\text{Cl}_2$ . Dried the
- 30 combined organic layers over  $\text{Na}_2\text{SO}_4$ , filtered and concentrated in vacuo. The residue was purified over silica gel column (5:94.5:0.5 MeOH:  $\text{CH}_2\text{Cl}_2$ : $\text{NH}_4\text{OH}$ ) to provide acetic acid 2-(5-nitro-2-pentafluoroethyl-phenoxy)-1-pyrrolidin-1-ylmethyl-ethyl ester as a yellow brown oil.

The following compounds were prepared similarly to the procedure outlined above:

- 5 a) (R) Acetic acid 2-(5-amino-2-pentafluoroethyl-phenoxy)-1-pyrrolidin-1-yl-methyl-ethyl ester.  
b) 1-(2,2-Dimethyl-6-nitro-2,3-dihydro-benzo[1,4]oxazin-4-yl)-ethanone. M-NO<sub>2</sub> 206.4; Calc'd 250.1.

10 **Preparation XLVIII - (R) 2-Chloro-N-[3-(2-hydroxy-2-pyrrolidin-1-yl-propoxy)-4-pentafluoroethyl-phenyl]-nicotinamide**

(R) Acetic acid 2-{5-[(2-chloro-pyridine-3-carbonyl)-amino]-2-pentafluoroethyl-phenoxy}-1-pyrrolidin-1-yl-ethyl ester  
15 (408 mg) was dissolved in MeOH (15 ml) and NH<sub>4</sub>OH (6 ml) was added and the mixture was stirred at RT for 6 h. The reaction was concentrated in vacuo and dried under high vacuum. The residue was purified over silica gel column (8:92:0.6 MeOH: CH<sub>2</sub>Cl<sub>2</sub>:NH<sub>4</sub>OH). The purified fractions were  
20 concentrated in vacuo and dried again to provide (R)-2-chloro-N-[3-(2-hydroxy-2-pyrrolidin-1-yl-ethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide as a white foam.

25 **Preparation XLIX - 2-Dimethylamino-1-(3,3-dimethyl-6-nitro-2,3-dihydro-indol-1-yl)-ethanone**

3,3-Dimethyl-6-nitro-2,3-dihydro-1H-indole (5 g) was dissolved in DMF (100 ml) and HOAt (3.89 g) dimethylamino-acetic acid (5.83 g) and EDC (3.89 g) were added. The reaction was stirred overnight. The mixture was diluted with  
30 CH<sub>2</sub>Cl<sub>2</sub> (1L) and washed with sat'd NaHCO<sub>3</sub> (3x200 ml). The organic layer was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo. The residue was purified by flash chromatography (SiO<sub>2</sub>, EtOAc to 5%MeOH/EtOAc) to afford the title compound.

The following compounds were prepared similarly to the procedure outlined above:

- 5 a) 1-(3,3-Dimethyl-6-nitro-2,3-dihydro-indol-1-yl)-2-(N-Boc-amino)-ethanone.

**Preparation L - 1-(6-Amino-3,3-dimethyl-2,3-dihydro-indol-1-yl)-2-(N-Boc-amino)-ethanone**

- 10 1-(3,3-Dimethyl-6-nitro-2,3-dihydro-indol-1-yl)-2-(N-Boc-amino)-ethanone (3.9 g) was dissolved in EtOH (30 ml) and Fe powder (3.1 g) NH<sub>4</sub>Cl (299 mg) and H<sub>2</sub>O (5 ml) were added. The reaction was stirred at 80°C overnight. The reaction was filtered through Celite® and evaporated off the MeOH. The  
15 residue was partitioned between CH<sub>2</sub>Cl<sub>2</sub> and sat'd NaHCO<sub>3</sub>. The organic layer was removed, washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo. The residue was purified by flash chromatography (SiO<sub>2</sub>, 25% EtOAc/hexane). The purified fractions were concentrated in vacuo to afford  
20 the compound as a white powder.

The following compounds were prepared similarly to the procedure outlined above:

- 25 a) 1-(6-Amino-3,3-dimethyl-2,3-dihydro-indol-1-yl)-2-dimethylamino-ethanone.  
b) 3,3-Dimethyl-1-(1-methyl-piperidin-4-ylmethyl)-2,3-dihydro-1H-indol-6-ylamine.  
c) 3-(4-Methyl-piperazin-1-ylmethyl)-4-pentafluoroethyl-phenylamine. M+H 324.2. Calc'd 323.  
30 d) 3,3-Dimethyl-1-(1-methyl-piperidin-4-yl)-2,3-dihydro-1H-indol-6-ylamine. M+H 259.6; Calc'd 259.3.  
e) 3,3-Dimethyl-1,1-dioxo-2,3-dihydro-1H-116-benzo[d]isothiazol-6-ylamine

f) 1,1,4,4-Tetramethyl-1,2,3,4-tetrahydro-naphth-6-ylamine.

g) 3,3-Dimethyl-1-(1-Boc-piperidin-4-ylmethyl)-2,3-dihydro-1H-indol-6-ylamine.

5 **Preparation LI - 2-Boc-4,4-dimethyl-7-nitro-1,2,3,4-tetrahydro-isoquinoline**

4,4-Dimethyl-7-nitro-1,2,3,4-tetrahydro-isoquinoline (150 mg) was dissolved with CH<sub>2</sub>Cl<sub>2</sub> (3 ml) DIEA (100 ul) DMAP (208 mg and Boc<sub>2</sub>O (204 mg) and the mixture was stirred for 6 h at  
10 RT. The reaction was diluted with CH<sub>2</sub>Cl<sub>2</sub>, washed with sat'd NaHCO<sub>3</sub> and dried over MgSO<sub>4</sub>, filtered and concentrated to provide the compound which was used without further purification.

15 The following compounds were prepared similarly to the procedure outlined above substituting Ac<sub>2</sub>O:

a) 1-(4,4-Dimethyl-7-nitro-3,4-dihydro-1H-isoquinolin-2-yl)-ethanone. M+H 249.3.

20 **Preparation LII - 2-Bromo-N-(4-methoxy-benzyl)-5-nitro-benzamide**

PMB-amine (5.35 ml) in CH<sub>2</sub>Cl<sub>2</sub> (130 ml) was slowly added to 2-bromo-5-nitro-benzoyl chloride (10.55 g) and NaHCO<sub>3</sub> (9.6  
25 g) and the mixture was stirred at RT for 1 h. The mixture was diluted with CH<sub>2</sub>Cl<sub>2</sub> (1 L), filtered, washed with dilute HCl, dried, filtered again, concentrated and dried under vacuum to provide the compound as a white solid. M+H 367. Calc'd 366.

30 **Preparation LIII - 2-Bromo-N-(4-methoxy-benzyl)-N-(2-methyl-allyl)-5-nitro-benzamide**

To a suspension of NaH (1.22 g) in DMF (130 ml) was added 2-bromo-N-(4-methoxy-benzyl)-5-nitro-benzamide (6.2 g) in DMF

2025 RELEASE UNDER E.O. 14176



(60 ml) at -78°C. The mixture was warmed to 0°C, 3-bromo-2-methyl-propene (4.57 g) was added and the mixture was stirred for 2 h at 0°C. The reaction was poured into ice water, extracted with EtOAc (2x400 ml), dried over MgSO<sub>4</sub>,  
5 filtered and concentrated to a DMF solution which was used without further purification.

**Preparation LIV - of 2-(4-Methoxy-benzyl)-4,4-dimethyl-7-nitro-3,4-dihydro-2H-isoquinolin-1-one**

10 2-Bromo-N-(4-methoxy-benzyl)-N-(2-methyl-allyl)-5-nitro-benzamide (23.4 mmol) was dissolved in DMF (150 ml) and Et<sub>4</sub>NCl (4.25 g), HCO<sub>2</sub>Na (1.75 g) and NaOAc (4.99 g) were added. N<sub>2</sub> was bubbled through the solution for 10 min, then Pd(OAc)<sub>2</sub> (490 mg) was added and the mixture was stirred  
15 overnight at 70°C. The mixture was extracted with EtOAc, washed with sat'd NH<sub>4</sub>Cl, dried over MgSO<sub>4</sub>, filtered and concentrated until the compound precipitated as a white solid.

20 The following compounds were prepared similarly to the procedure outlined above:

a) 3,3-Dimethyl-6-nitro-2,3-dihydro-benzofuran was prepared from 1-bromo-2-(2-methyl-allyloxy)-4-nitro-benzene.

25 b) 3,9,9-Trimethyl-6-nitro-4,9-dihydro-3H-3-aza-fluorene was prepared from 4-[1-(2-bromo-4-nitro-phenyl)-1-methyl-ethyl]-1-methyl-1,2,3,6-tetrahydro-pyridine.

**Preparation LV - 4,4-Dimethyl-7-nitro-3,4-dihydro-2H-isoquinolin-1-one**

30 2-(4-Methoxy-benzyl)-4,4-dimethyl-7-nitro-3,4-dihydro-2H-isoquinolin-1-one (2.0 g) was dissolved in CH<sub>3</sub>CN (100 ml) and H<sub>2</sub>O (50 ml) and cooled to 0°C. CAN (9.64 g) was added and the reaction was stirred at 0°C for 30 min, then warmed

to RT and stirred for 6 h. The mixture was extracted with  $\text{CH}_2\text{Cl}_2$  (2x300 ml) washed with sat'd  $\text{NH}_4\text{Cl}$ , dried over  $\text{MgSO}_4$ , filtered and concentrated. The crude material was recrystallized in  $\text{CH}_2\text{Cl}_2/\text{EtOAc}$  (1:1) to give 4,4-dimethyl-7-nitro-3,4-dihydro-2H-isoquinolin-1-one as a white solid.

**Preparation LVI - 4,4-Dimethyl-7-nitro-1,2,3,4-tetrahydro-isoquinoline**

4,4-Dimethyl-7-nitro-3,4-dihydro-2H-isoquinolin-1-one (230 mg) was dissolved in THF (10 ml) and  $\text{BH}_3\text{Me}_2\text{S}$  (400  $\mu\text{l}$ ) was added and the reaction was stirred overnight at RT. The reaction was quenched with MeOH (10 ml) and NaOH (200 mg) and heating at reflux for 20 min. The mixture was extracted with EtOAc, washed with sat'd  $\text{NH}_4\text{Cl}$ , extracted with 10% HCl (20 ml). The acidic solution was treated with 5N NaOH (15 ml), extracted with EtOAc (30 ml) dried, filtered and evaporated to give the compound as a yellow solid. M+H 207.2, Calc'd 206.

The following compounds were prepared similarly to the procedure outlined above:

a) 4-Boc-2,2-dimethyl-6-nitro-3,4-dihydro-2H-benzo[1,4]oxazine.

**Preparation LVII - 2-Bromomethyl-4-nitro-1-pentafluoroethyl-benzene**

2-Methyl-4-nitro-1-pentafluoroethyl-benzene (2.55 g) was dissolved in  $\text{CCl}_4$  (30 ml) and AIBN (164 mg) and NBS (1.96 g) were added. The reaction was heated to reflux and stirred for 24 h. The mix was diluted with  $\text{CH}_2\text{Cl}_2$ , washed with sat'd  $\text{NaHCO}_3$ , dried over  $\text{MgSO}_4$  and concentrated to give the compound as an oil which was used without further purification.

**Preparation LVIII - 1-Methyl-4-(5-nitro-2-pentafluoroethyl-benzyl)-piperazine**

2-Bromomethyl-4-nitro-1-pentafluoroethyl-benzene (2.6 g) was  
5 added to N-methylpiperazine (5 ml) and stirred at RT for 3  
h. The mixture was filtered and the filtrate was treated  
with 1-chlorobutane, extracted with 2N HCl (100 ml). The  
acidic solution was treated with 5N NaOH (6 ml) then  
extracted with EtOAc. The organic layer was removed, dried  
10 over MgSO<sub>4</sub> and concentrated to give the compound as an oil.

The following compounds were prepared similarly to the  
procedure outlined above:

15 a) 4-(5-Nitro-2-pentafluoroethyl-benzyl)-morpholine.

**Preparation LIX - 1-Boc-4-(5-nitro-2-pentafluoroethyl-benzyl)-piperazine.**

20 2-Bromomethyl-4-nitro-1-pentafluoroethyl-benzene (2.5 g) was  
dissolved in CH<sub>2</sub>Cl<sub>2</sub> and added to N-Boc-piperazine (2.5 g)  
and NaHCO<sub>3</sub> (1 g) and stirred at RT overnight. The mixture  
was diluted with CH<sub>2</sub>Cl<sub>2</sub> (100 ml), washed with sat'd NH<sub>4</sub>Cl,  
dried over MgSO<sub>4</sub>, filtered and concentrated. The residue was  
25 purified by silica gel chromatography (hexane, CH<sub>2</sub>Cl<sub>2</sub>:hexane  
2:8) to give the compound as a yellow solid.

**Preparation LX - (4-Boc-piperazin-1-yl)-(3-nitro-5-trifluoromethyl-phenyl)-methanone**

30 A mixture of 3-nitro-5-trifluoromethyl-benzoic acid (4.13  
g), 4-Boc-piperazine (2.97 g), EDC (3.88 g), HOBt (2.74 g),  
DIEA (3.33 ml) in CH<sub>2</sub>Cl<sub>2</sub> (120 ml) was stirred at RT for 3 h.  
The mixture was diluted with CH<sub>2</sub>Cl<sub>2</sub> (100 ml), washed with  
sat'd NH<sub>4</sub>Cl, dried over MgSO<sub>4</sub>, filtered and concentrated.

The residue was purified by silica gel chromatography (hexane, CH<sub>2</sub>Cl<sub>2</sub>:hexane 1:2) to give the compound as a white solid.

5 **Preparation LXI - 1-Boc-4-(3-nitro-5-trifluoromethyl-benzyl)-piperazine**

(4-Boc-piperazin-1-yl)-(3-nitro-5-trifluoromethyl-phenyl)-methanone (403 mg) was dissolved in THF (6 ml) and BH<sub>3</sub>Me<sub>2</sub>S (300 µl) was added and the reaction was stirred for 3 h at 10 60°C and 2 h at RT. The reaction was quenched with MeOH (5 ml) and NaOH (100 mg) and stirred at RT for 1 h. The mixture was concentrated and dissolved in CH<sub>2</sub>Cl<sub>2</sub>, washed with sat'd NH<sub>4</sub>Cl/NaHCO<sub>3</sub>, dried (MgSO<sub>4</sub>), filtered and evaporated to give the compound as an oil. M+H 390.3.

15

**Preparation LXII - 2-Ethyl-4-aminomethyl pyridine**

To a solution of 2-ethyl-4-thiopyridylamide (10 g) in MeOH (250 ml) was added Raney 2800 Nickel (5 g, Aldrich) in one portion. The mixture was stirred at RT for 2 days then at 20 60°C for 16 h. The mixture was filtered, concentrated to provide the desired compound.

**Preparation LXIII - N-Boc-[2-(4-morpholin-4-yl-butyl)-pyrimidin-4-ylmethyl]-amine**

25 N-Boc-(2-chloropyrimidine)-methylamine (663 mg) and 4-(aminopropyl)morpholine (786 mg) were dissolved in MeOH and concentrated in vacuo. The residue was heated at 100°C for 15 min, forming a solid which was dissolved in CH<sub>2</sub>Cl<sub>2</sub>/MeOH then concentrated again and heated 15 min more.  
30 Concentrated in vacuo and dried under high vacuum. Triturated with a small amount of IpOH and allowed to settle over a weekend. Filtered, rinsing with a small amount of IpOH to provide the compound as a white solid.

The following compounds were prepared similarly to the procedure outlined above:

- 5 a) (4-Bocaminomethyl-pyrimidin-2-yl)-[2-(1-methyl-pyrrolidin-2-yl)-ethyl]-amine. M+H 336.5; Calc'd 335.45.

**Preparation LXIV - 2-fluoronicotinic acid**

10 In a flame dried 3-necked round bottom flask equipped with a dropping funnel and thermometer, under N<sub>2</sub>, THF (250 ml) was added via cannula. LDA (2M in cyclohexane, 54 ml) was added via cannula as the flask was cooled to -78°C. At -78°C, 2-fluoropyridine (8.87 ml) was added dropwise over 10 min. The reaction was stirred for 3 h. Condensation was blown off (with N<sub>2</sub>) a few cubes of solid CO<sub>2</sub> and they were added to  
15 the mixture. The mixture was warmed to RT once the solution turned yellow, and it was stirred overnight. The reaction was cooled to 0°C and the pH was adjusted to ~2.5 with 5N HCl. The mixture was concentrated in vacuo and extracted with EtOAc. The EtOAc layer was washed with brine, dried  
20 over MgSO<sub>4</sub>, filtered and concentrated to dryness. The resulting solid was slurried in EtOAc (100 ml), filtered, washed with cold EtOAc and dried at 50°C for 1 h to afford 2-fluoronicotinic acid. M+H 142.1; Calc'd 141.0.

25 **Preparation LXV - 4-cyano-2-methoxypyridine**

Under a stream of N<sub>2</sub> and with cooling, Na metal (2.7 g) was added to MeOH (36 ml) with a considerable exotherm. After the Na is dissolved, a solution of 2-chloro-4-cyanopyridine (15 g) in dioxane:MeOH (1:1, 110 ml) was added via dropping  
30 funnel over a 10 min period. The reaction was heated to reflux for 3.5 h then cooled at ~10°C overnight. Solid was filtered off and the solid was washed with MeOH. The filtrate was concentrated to ~60 ml and H<sub>2</sub>O (60 ml) was added to redissolve a precipitate. Upon further

concentration, a precipitate formed which was washed with H<sub>2</sub>O. Further concentration produced additional solids. The solids were combined and dried in vacuo overnight at 35°C to provide 4-cyano-2-methoxypyridine which was used as is.

5

**Preparation LXVI - (2-methoxypyridin-4-yl)methylamine**

4-Cyano-2-methoxypyridine (1.7 g) was dissolved in MeOH (50 ml) and conc. HCl (4.96 ml) was added. Pd/C (10%) was added and H<sub>2</sub> was added and let stand overnight. The solids were  
10 filtered through Celite® and the cake was washed with MeOH (~250 ml). Concentration in vacuo produced an oil which was dissolved in MeOH (~20 ml). Et<sub>2</sub>O (200 ml) was added and stirred for 1 h. The resulting precipitate was filtered and washed with Et<sub>2</sub>O to afford (2-methoxypyridin-4-  
15 yl)methylamine (hydrochloride salt) as an off-white solid.

**Preparation LXVII - 2-(4-Amino-phenyl)-2-methyl-propionic acid methyl ester**

2-Methyl-2-(4-nitro-phenyl)-propionic acid methyl ester (2.1  
20 g) was dissolved in THF (70 ml) and acetic acid (5 ml) and Zn (10 g) were added. The mixture was stirred for 1 h and filtered through Celite®. The filtrate was rinsed with EtOAc and the organics were evaporated to a residue which was purified on silica gel chromatography (40%EtOAc/hexanes) to  
25 provide the desired compound as a yellow oil. M+H 194.

**Preparation LXVIII - 1-(2-tert-Butyl-phenyl)-4-methyl-piperazine**

2-tert-Butyl-phenylamine and bis-(2-chloro-ethyl)-  
30 methylamine were mixed together with K<sub>2</sub>CO<sub>3</sub> (25 g), NaI (10 g) and diglyme (250 mL) and heated at 170°C for 8 h. Cooled and filtered solid and evaporated solvent. Diluted with EtOAc, washed with NaHCO<sub>3</sub> solution, extracted twice more

20070325400F

with EtOAc, washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub> and evaporated to give the compound as a dark solid.

The following compounds were prepared similarly to the  
5 procedure outlined above:

a) 1-Bromo-2-(2-methyl-allyloxy)-4-nitro-benzene was prepared from methallyl bromide.

10 **Preparation LXIX 3-(1-Methyl-1,2,3,6-tetrahydro-pyridin-4-yl)-5-trifluoromethyl-phenylamine**

3-(5,5-Dimethyl-[1,3,2]dioxaborinan-2-yl)-5-trifluoromethyl-phenylamine (8.8g, 0.032mol) was added to trifluoromethanesulfonic acid 1-methyl-1,2,3,6-tetrahydro-pyridin-4-yl ester (7.91g, 0.032mol) and 2N Na<sub>2</sub>CO<sub>3</sub> aqueous solution (25mL) was bubbled through N<sub>2</sub> for 5 min. Pd(PPh<sub>3</sub>)<sub>4</sub> (3.7g, 3.2mmol) was added and the reaction was heated to 80°C for 16 h. The reaction was cooled to RT and diluted with Et<sub>2</sub>O (100 mL). The mixture was filtered through Celite® and the  
15 filtrate was washed with NaHCO<sub>3</sub> aqueous solution (25 ml) followed by brine (25 mL). The organic phase was dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuo. The desired product was isolated by passing through silica gel column chromatography (EtOAc, then (2M NH<sub>3</sub>) in MeOH/EtOAc) to provide a yellow  
20 oil.  
25

**Preparation LXX - 3,3-Dimethyl-6-nitro-2,3-dihydro-benzo[d]isothiazole 1,1-dioxide**

3,3-Dimethyl-2,3-dihydro-benzo[d]isothiazole 1,1-dioxide was  
30 added to KNO<sub>3</sub> in H<sub>2</sub>SO<sub>4</sub> cooled to 0°C and stirred for 15 min. The reaction was warmed to RT and stirred overnight. The mix was poured into ice and extracted with EtOAc (3x), washed with H<sub>2</sub>O and brine, dried and evaporated to give the product which was used without further purification.

2004-03-04 10:00

The following compounds were prepared similarly to the procedure outlined above:

- 5 a) 1,1,4,4-Tetramethyl-6-nitro-1,2,3,4-tetrahydro-naphthalene

**Preparation LXXI - 3-(1-Methyl-1,2,3,4-tetrahydro-pyridin-4-yl)-5-trifluoromethyl-phenylamine**

- 10 3-(5,5-Dimethyl-[1,3,2]dioxaborinan-2-yl)-5-trifluoromethyl-phenylamine (1.2 g) was added to trifluoro-methanesulfonic acid 1-methyl-1,2,3,6-tetrahydro-pyridin-4-yl ester (1.0 g), LiCl (500 mg, Aldrich), PPh<sub>3</sub> (300 mg, Aldrich) and 2M Na<sub>2</sub>CO<sub>3</sub> aqueous solution (6 ml) and was bubbled with N<sub>2</sub> for 5 min.
- 15 Pd(PPh<sub>3</sub>)<sub>4</sub> (300 mg, Aldrich) was added and the reaction was heated to 80°C for 16 h. The reaction was cooled to RT and diluted with Et<sub>2</sub>O (100 mL). The mixture was filtered through Celite® and the filtrate was washed with NaHCO<sub>3</sub> aqueous solution (25 ml) followed by brine (25 mL). The
- 20 organic phase was dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The desired compound was isolated by silica gel column chromatography (EtOAc 10% (2M NH<sub>3</sub>) in MeOH/EtOAc) to provide yellow oil. M+H 257.2; Calc'd 256.1.

- 25 **Preparation LXXII - Trifluoromethylsulfonic acid 1-methyl-1,2,3,6-tetrahydro-pyridin-4-yl ester**

- In a three-necked round bottom flask equipped with a thermometer and an additional funnel was placed anhydrous THF (200 mL) and 2M LDA (82.8 mL). The solution was cooled
- 30 to -78°C and a solution of 1-methyl-piperidin-4-one (20 mL) in anhydrous THF (70 mL) was added drop-wise. The reaction was warmed to -10°C over 30 min and cooled down again to -78°C. Tf<sub>2</sub>NPh (54.32 g) in 200 mL of anhydrous THF was added through the additional funnel over 30 min and anhydrous THF



(30 mL) was added to rinse the funnel. The reaction was warmed to RT and the reaction solution was concentrated in vacuo. The residue was dissolved in Et<sub>2</sub>O purified on neutral Al<sub>2</sub>O<sub>3</sub> column chromatography (Et<sub>2</sub>O as elutant). The product was obtained as orange oil. (20 g)

**Preparation LXXIII - 3-(5,5-Dimethyl-[1,3,2]dioxaborinan-2-yl)-5-trifluoromethyl-phenylamine**

N<sub>2</sub> was bubbled through a solution of 3-bromo-5-trifluoromethyl-phenylamine (2.38 g), 5,5,5',5'-tetramethyl-[2,2']bi[[1,3,2]dioxaborinanyl] (2.24 g, Frontier Scientific) and KOAc (2.92 g), dppf (165 mg, Aldrich) in anhydrous dioxane (50 ml) for 2 min. PdCl<sub>2</sub> (dppf) (243 mg, Aldrich) was added and the reaction was heated to 80°C for 4 h. After cooling to RT, the mix was diluted with 50 mL of Et<sub>2</sub>O, filtered through Celite®, and the filtrate was concentrated in vacuo. The residue was dissolved in Et<sub>2</sub>O (100 mL), washed with sat. NaHCO<sub>3</sub> aqueous solution (50 mL) followed by brine (50 mL). The organic phase was dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuo. The residue was dissolved in 3:2 Et<sub>2</sub>O/Hex (100 mL), filtered through Celite® and the filtrate was concentrated in vacuo to afford a dark brown semi-solid.

**Preparation LXXIV - 1-Boc-3-Hydroxymethyl-azetidine**

A solution of 1-Boc-azetidine-3-carboxylic acid (1.6 g) and Et<sub>3</sub>N (2 ml) in anhydrous THF (60 ml) was cooled to 0°C. Isopropyl chloroformate (1.3 g) was added via a syringe slowly; forming a white precipitate almost immediately. The reaction was stirred for 1 h at 0°C and the precipitate was filtered out. The filtrate was cooled to 0°C again and aqueous NaBH<sub>4</sub> solution (900 mg, 5 ml) was added via pipette and stirred for 1 h. The reaction was quenched with NaHCO<sub>3</sub> solution (50 mL) and the product was extracted with EtOAc

(200 mL). The organic phase was washed with brine (50 mL), dried over  $\text{Na}_2\text{SO}_4$  and concentrated *in vacuo*. The residue was dissolved in EtOAc and passed through a short silica gel pad. Concentrating the filtrate *in vacuo* provided the compound as a light yellow oil.

**Preparation LXXV - 1-Boc-3-(3-nitro-5-trifluoromethyl-phenoxy)methyl)-azetidine**

A mixture of 1-Boc-3-methylsulfonyloxymethyl-azetidine (1.47 g), 3-nitro-5-trifluoromethyl-phenol (1.15 g) and  $\text{K}_2\text{CO}_3$  (1.15 g) in DMF (20 mL) at  $80^\circ\text{C}$  was stirred overnight. The reaction was cooled to RT and diluted with 25 mL of sat.  $\text{NaHCO}_3$  and 50 mL of EtOAc. The organic phase was separated and washed with brine (25 mL), dried over  $\text{Na}_2\text{SO}_4$  and concentrated *in vacuo*. The crude compound was purified by column chromatography (50% EtOAc/hex).

**Preparation LXXVI - 2,2-Dimethyl-6-nitro-3,4-dihydro-2H-benzo[1,4]oxazine**

2,2-Dimethyl-6-nitro-4H-benzo[1,4]oxazin-3-one was added to  $\text{BH}_3$ -THF complex (Aldrich) in THF with ice cooling. The mixture was heated to reflux for 2 h then carefully diluted with 12 mL of MeOH and heated to reflux for an additional 1 h. Concentrated HCl (12 mL) was added and heated to reflux for 1 h. The mixture was concentrated and the resulting solid was suspended in a dilute aqueous solution of NaOH (1 M) and extracted with EtOAc (100 mL x 4). The organic layers were washed with  $\text{H}_2\text{O}$  and dried over  $\text{MgSO}_4$ . Evaporation of solvent gave a yellow solid.

**Preparation LXXVII - 2,2,4-Trimethyl-6-nitro-4H-benzo[1,4]oxazin-3-one**

2,2-Dimethyl-6-nitro-4H-benzo[1,4]oxazin-3-one (1.1 g) was mixed with MeI (850 mg, Aldrich),  $\text{K}_2\text{CO}_3$  (1.38 g, Aldrich)

and DMF (30 ml, Aldrich) at 40°C for 48 h. The DMF was removed in vacuo and the residue was diluted with EtOAc (80 ml). The organic phase was washed with H<sub>2</sub>O (50 ml), aqueous Na<sub>2</sub>SO<sub>3</sub> (50 ml) and brine (50 ml). The resulting solution was dried (MgSO<sub>4</sub>) and concentrated to provide the compound which was used as is.

**Preparation LXXVIII - 2-Bromo-N-(2-hydroxy-5-nitro-phenyl)-2-methyl-propionamide**

2-Amino-4-nitro-phenol (3.08 g, Aldrich) was stirred with THF (30 ml, Aldrich) in an ice bath. 2-Bromo-2-methyl-propionyl bromide (2.47 ml, Aldrich) and Et<sub>3</sub>N (2.0 g, Aldrich) was slowly added via syringe. The mixture was stirred for 45 min then poured into ice. The aqueous phase was extracted by EtOAc (50 mL x 4). The organic layer was dried and concentrated. The desired product was crystallized from EtOAc. (*Chem. Pharm. Bull* 1996, 44(1) 103-114).

**Preparation LXXIX - 2,2-Dimethyl-6-nitro-4H-benzo[1,4]oxazin-3-one**

2-Bromo-N-(2-hydroxy-5-nitro-phenyl)-2-methyl-propionamide was mixed with K<sub>2</sub>CO<sub>3</sub> in 20 mL of DMF and stirred overnight at 50°C. The reaction mixture was poured into ice water. The precipitate was collected by filtration and washed with H<sub>2</sub>O. The crude compound was recrystallized from EtOH.

**Preparation LXXX -4-[1-(2-Bromo-4-nitro-phenyl)-1-methyl-ethyl]-1-methyl-pyridinium iodide**

1-Methyl-4-[1-methyl-1-(4-nitro-phenyl)-ethyl]-pyridinium (8 g) was dissolved in glacial HOAc (10 ml) then diluted with H<sub>2</sub>SO<sub>4</sub> (50 ml), then NBS (3.8 g) was added. After 1 h, additional NBS (1.2 g) was added, 30 min later another 0.5 g of NBS, then 15 min later 200 mg more NBS. After 1 h, the

mixture was neutralized with  $\text{NH}_4\text{OH}$  (conc.) with ice bath cooling. The neutralized mixture was then concentrated and used as is.

5 **Preparation LXXXI - 4-[1-(2-Bromo-4-nitro-phenyl)-1-methyl-ethyl]-1-methyl-1,2,3,6-tetrahydro-pyridine**

4-[1-(2-Bromo-4-nitro-phenyl)-1-methyl-ethyl]-1-methyl-pyridiniumiodide was mixed with MeOH (400 ml) and  $\text{CH}_2\text{Cl}_2$  (200 ml), then treated with  $\text{NaBH}_4$  (2.5 g) in portions.

10 After stirring at RT for 2 h, the mixture was extracted with  $\text{CH}_2\text{Cl}_2$  (300 mL x 3). The  $\text{CH}_2\text{Cl}_2$  layer was washed with brine, dried over  $\text{Na}_2\text{SO}_4$  and concentrated *in vacuo*, to provide the desired product.

15 **Preparation LXXXII - 1-Methyl-4-[1-methyl-1-(4-nitro-phenyl)-ethyl]-pyridinium iodide**

4-(4-Nitro-benzyl)-pyridine (4.3 g) was mixed with MeI (4 ml, 9.12 g)/NaOH (5N, 30 ml),  $\text{Bu}_4\text{NI}$  (150 mg) and  $\text{CH}_2\text{Cl}_2$  (50 ml) and stirred at RT overnight. Additional MeI (2 mL) was  
20 added along with 50 mL of NaOH (5N). 6 h later, more MeI (2 mL) was added. The mixture was stirred at RT over the weekend. The mixture was cooled on ice bath and the base was neutralized by conc. HCl (aq) addition dropwise to pH 7. The compound was used as is.

25

**Preparation LXXXIII - 1-Methyl-4-(4-nitro-benzyl)-1,2,3,6-tetrahydro-pyridine**

4-(4-Nitrobenzyl)pyridine (64 g) and TBAI (6 g) were dissolved in  $\text{CH}_2\text{Cl}_2$  (500 mL) and the solution was suspended  
30 with NaOH (aq. 5N, 450 mL) in a 3L 3-necked round bottom flask. With vigorous stirring, iodomethane (213 g) was added and stirred vigorously at RT for 60 h (or until blue color disappears). The reaction was quenched with dimethylamine (100 mL) and MeOH (300 mL) and stirred for 2 h.  $\text{NaBH}_4$  (19

g) was added to the mixture in small portions. The reaction mixture was stirred for 30 min at RT, then partitioned between  $\text{CH}_2\text{Cl}_2/\text{H}_2\text{O}$  (500 mL/500 mL). The organic layer was collected and the aqueous layer was washed with  $\text{CH}_2\text{Cl}_2$  (300 mL x 3). The combined organic layers was washed with brine then concentrated in vacuo. The residue was purified on a silica wash-column (7% TEA in EtOAc). The desired fractions were combined and concentrated under vacuum to give the desired compound as a dark gray solid. (MS:  $M+1=261$ ).

**Preparation LXXXIV - 1-Boc-4-formylpiperidine**

4A Molecular sieves were heated to  $100^\circ\text{C}$  and a vacuum was applied. They were cooled to RT and purged with  $\text{N}_2$ .  $\text{CH}_2\text{Cl}_2$  (420 ml) and  $\text{CH}_3\text{CN}$  (40 ml), NMO (40 g) and 1-Boc-4-hydroxymethylpiperidine (50 g) were added and the mix was stirred for 5 min then cooled to  $15^\circ\text{C}$ . TPAP (4.1 g) is added and an exotherm was observed. The reaction was maintained at RT with external cooling. The reaction was stirred at RT for 3 h, filtered, concentrated, diluted with 50% EtOAc/hexanes and purified on a silica gel plug (50%EtOAc/hexanes). The eluant fractions were concentrated to afford a yellow oil.

**Preparation LXXXV 2-Chloro-4-cyanopyridine**

2-Chloro-4-cyanopyridine was prepared similar to the method described by Daves et al., J. Het. Chem., 1, 130-32 (1964).

**Preparation LXXXVI 4-(2-tert-Butyl-5-nitro-phenyl)-but-3-en-1-ol**

A mix of 1-(tert-butyl)-2-bromo-4-nitrobenzene (3.652 g), TEA (5.92 ml), 3-buten-1-ol (5.48 ml),  $\text{Pd}(\text{OAc})_2$  (32 mg),  $\text{Pd}(\text{PPh}_3)_4$  (327 mg) and toluene (40 ml) was degassed with nitrogen and heated in a sealed vessel for 16 h at  $120^\circ\text{C}$ .

5

## 10

15

## 20

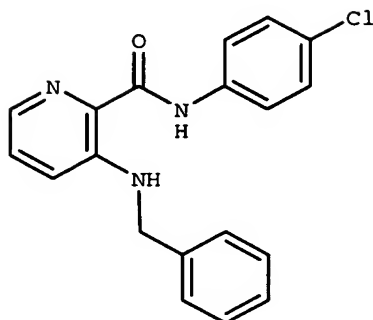
25

30

**Preparation LXXXVIV N-Boc-(2-chloropyrimidin-4-yl)-  
methylamine**

To 2-chloropyrimidine-4-carbonitrile [2.5 g, prepared by the  
5 procedure of Daves et. al. [*J. Het. Chem.* 1964, 1, 130-132)]  
in EtOH (250 ml) under N<sub>2</sub> was added Boc<sub>2</sub>O (7.3 g). After  
the mixture was briefly placed under high vacuum and flushed  
with N<sub>2</sub>, 10% Pd/C (219 mg) was added. H<sub>2</sub> was bubbled through  
the mixture (using balloon pressure with a needle outlet) as  
10 it stirred 4.2 h at RT. After filtration through Celite®,  
addition of 1.0 g additional Boc<sub>2</sub>O, and concentration, the  
residue was purified by silica gel chromatography (5:1 →  
4:1 hexanes/EtOAc) to obtain N-Boc-(2-chloropyrimidin-4-yl)-  
methylamine.

200710 "9254004  
1045526 011002

**Example 1****N-(4-Chlorophenyl){3-[benzylamino](2-pyridyl)}carboxamide**

5

**Step A - Preparation of (3-amino-(2-pyridyl))-N-(4-chlorophenyl)carboxamide**

To a mixture of 3-aminopicolinic acid (552 mg, 4.0 mmol, 1.0 eq) and 4-chloroaniline (1.02 g, 8.0 mmol, 2.0 eq) in CH<sub>2</sub>Cl<sub>2</sub> was added EDC (1.2 eq), HOBt (0.5 eq) and TEA (1.2 eq). The reaction was stirred at RT overnight, diluted with CH<sub>2</sub>Cl<sub>2</sub>, washed with NH<sub>4</sub>Cl, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated *in vacuo*, purified by flash chromatography (4% MeOH/CH<sub>2</sub>Cl<sub>2</sub>) to give the amide as a white solid. MS (ES<sup>+</sup>): 248 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 246 (M-H)<sup>-</sup>.

15

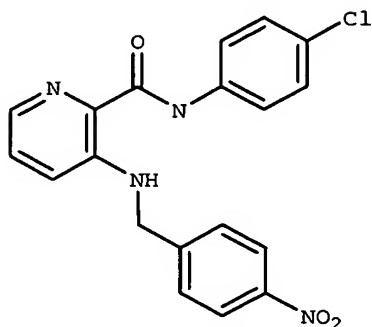
**Step B - Preparation of N-(4-chlorophenyl){3-[(4-phenylmethyl)amino](2-pyridyl)}carboxamide**

To a mixture of the amide from Step A (1.0 eq.) and 4-benzaldehyde (1.0 eq.) in CH<sub>2</sub>Cl<sub>2</sub> was added NaBH(OAc)<sub>3</sub> (1.5 eq). The resulted mixture was stirred for 2 days at RT, diluted with CH<sub>2</sub>Cl<sub>2</sub>, washed with saturated NH<sub>4</sub>Cl solution, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated. The crude material was purified through flash chromatography (4% MeOH/CH<sub>2</sub>Cl<sub>2</sub>) to give the title compound as a white solid. MS (ES<sup>+</sup>): 338 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 336 (M-H)<sup>-</sup>. Calc'd for C<sub>19</sub>H<sub>16</sub>ClN<sub>3</sub>O - 337.81.

25

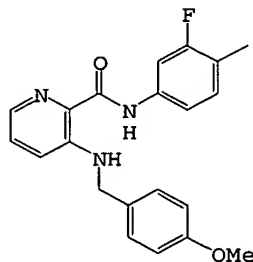


The following compounds (Examples 2-4) were analogously synthesized by the method described in Example 1.

**Example 2**

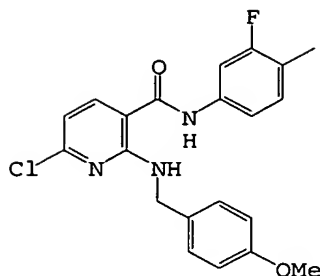
**N-(4-Chlorophenyl)(3-((4-nitrophenyl)methyl)amino)(2-pyridyl)-carboxamide**

MS (ES<sup>+</sup>): 383 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 381 (M-H)<sup>-</sup>. Calc'd for C<sub>19</sub>H<sub>15</sub>ClN<sub>4</sub>O<sub>3</sub> - 382.81.

**Example 3**

**(2-((4-methoxyphenyl)methyl)amino)-N-(3-fluoro-4-methylphenyl)carboxamide**

MS (ES<sup>+</sup>): 366 (M+H)<sup>+</sup>. Calc'd for C<sub>21</sub>H<sub>20</sub>FN<sub>3</sub>O<sub>2</sub> - 365.41.

**Example 4**

5 (6-Chloro-2-[[[(4-methoxyphenyl)methyl]amino]pyridine-3-carboxylic acid)-(3-fluoro-4-methylphenyl)carboxamide

**Step A - Preparation of 6-chloro-2-[[[(4-methoxyphenyl)methyl]amino]pyridine-3-carboxylic acid**

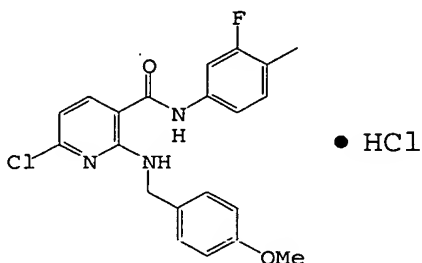
10 A mixture of 2,6-dichloronicotinic acid (1 g, 5.5 mmol) and 4-methoxybenzylamine (1 ml, 7.7 mmol) in a sealed tube was heated at 150°C for 3h and 120°C for 16h. The resulting solution was cooled to RT and CH<sub>2</sub>Cl<sub>2</sub> (10 ml) was added. A precipitate which formed was filtered and washed with CH<sub>2</sub>Cl<sub>2</sub> (20 ml). The filtrate was concentrated,  
15 dissolved in EtOAc (30 ml), and extracted with NaOH (2N, 3x15 ml). The combined aqueous solution was acidified with HCl (1N) to pH 7, and extracted with CH<sub>2</sub>Cl<sub>2</sub> (3x20 ml). The combined extracts were dried and concentrated. The compound was purified on SiO<sub>2</sub> column (eluted with a solution of  
20 hexane-EtOAc 2:1) to give a yellowish solid.

**Step B - Preparation of (6-chloro-2-[[[(4-methoxyphenyl)methyl]amino]pyridine-3-carboxylic acid)-(3-fluoro-4-methylphenyl)carboxamide**

25 A mixture of 6-chloro-2-[[[(4-methoxyphenyl)methyl]amino]pyridine-3-carboxylic acid from Step A (100 mg, 0.34 mmol), EDC (107 mg, 0.56 mmol), HOBt (51 mg, 0.37 mmol) and DIEA (0.1 ml) in CH<sub>2</sub>Cl<sub>2</sub> (10 ml) was stirred at RT under N<sub>2</sub> atmosphere for 16 h. It was taken up in CH<sub>2</sub>Cl<sub>2</sub> and washed

with H<sub>2</sub>O then aqueous NaHCO<sub>3</sub>. The CH<sub>2</sub>Cl<sub>2</sub> was evaporated and the oil was placed on a silica gel GF prep plate and eluted with a solution of hexane-EtOAc (4:1). M+H 400.2, M-H 398.1. Calc'd for C<sub>21</sub>H<sub>19</sub>ClFN<sub>3</sub>O<sub>2</sub>: 399.1.

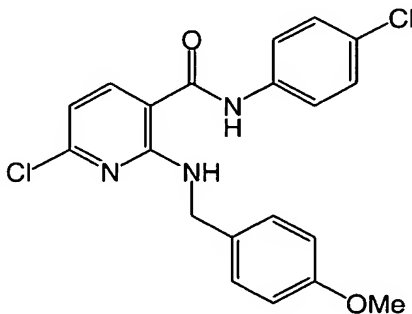
5

**Example 5**

10    **(6-Chloro-2-[[[(4-methoxyphenyl)methyl]amino[(3-pyridyl))-N-(3-fluoro-4-methylphenyl)carboxamide hydrochloride**

          (6-Chloro-2-[[[(4-methoxyphenyl)methyl]amino[(3-pyridyl))-N-(3-fluoro-4-methylphenyl)carboxamide (Example 4)  
15    was dissolved in MeOH (0.5 ml) and added to a solution of HCl-Et<sub>2</sub>O. The precipitate was collected and washed with Et<sub>2</sub>O to give light yellow solid. MS (ES<sup>+</sup>): 400.2 (M+H); (ES<sup>-</sup>): 398 (M-H). Calc'd for C<sub>21</sub>H<sub>19</sub>ClFN<sub>3</sub>O<sub>2</sub> - 399.851.

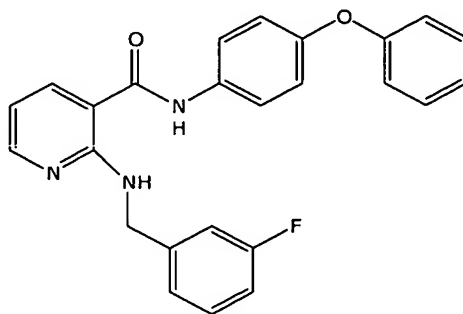
20

**Example 6**

**(6-Chloro-2-[[ (4-methoxyphenyl)methyl]amino] (3-pyridyl))-N-(4-chlorophenyl)carboxamide**

The title compound was analogously synthesized by  
5 method described in Example 4. MS (ES<sup>+</sup>): 403 (M+H); (ES<sup>-</sup>):  
401 (M-H). Calc'd for C<sub>20</sub>H<sub>17</sub>Cl<sub>2</sub>N<sub>3</sub>O<sub>2</sub> - 402.28.

**Example 7**



10

**2-(3-Fluoro-benzylamino)-N-(4-phenoxy-phenyl)-nicotinamide**

**Step A: Preparation of 2-chloro-N-(4-phenoxy-phenyl)-**  
15 **nicotinamide**

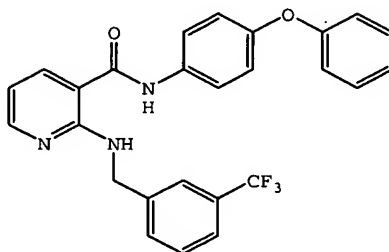
2-Chloropyridine-3-carbonyl chloride (9.15 g, 0.052  
mol) was added to a stirred solution of 4-phenoxyaniline  
(10.00 g, 0.054 mol) and DIEA (10.00 ml, 0.057 mol) in  
CH<sub>2</sub>Cl<sub>2</sub> (100 ml) at RT. The mixture was stirred for 48 h  
20 before removal of solvent under reduced pressure. The  
resulting residue was dissolved in EtOAc and washed several  
times with saturated NaHCO<sub>3</sub> aqueous solution and brine,  
respectively. The organic layer was dried over Na<sub>2</sub>SO<sub>4</sub> and  
evaporated to dryness. This material was re-crystallized  
25 from EtOAc/Hexane mixtures followed by filtration and  
rinsing with Et<sub>2</sub>O to leave the desired compound as a white  
solid. MS m/z: 325 (M+1); 323 (M-1)

**Step B: 2-(3-Fluoro-benzylamino)-N-(4-phenoxy-phenyl)-nicotinamid**

2-Chloro-N-(4-phenoxy-phenyl)-nicotinamide (0.025 g, 0.077 mmol) (Step A) and 3-fluorobenzylamine (0.029 g, 2.31 mmol) were combined and heated at 120°C neat for 18 h. After cooling to RT, the title compound was obtained through purification via preparative HPLC as the TFA salt. MS: (ES+) 414 (M+1)<sup>+</sup>; (ES-): 412 (M-1)<sup>-</sup>. Calc'd. for C<sub>25</sub>H<sub>20</sub>FN<sub>3</sub>O<sub>2</sub> - 413.15.

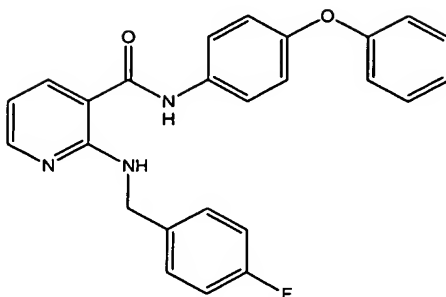
The following compounds (Examples 8-37) were prepared by the method similar to that described in Example 7.

**Example 8**



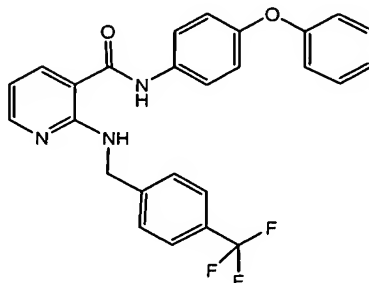
**N-(4-Phenoxy-phenyl)-2-(3-trifluoromethyl-benzylamino)-nicotinamide**

MS: (ES+) 464 (M+1)<sup>+</sup>; (ES-): 462 (M-1)<sup>-</sup>. Calc'd. for C<sub>26</sub>H<sub>20</sub>F<sub>3</sub>N<sub>3</sub>O<sub>2</sub> - 463.15.

**Example 9**5      **2-(4-Fluorobenzylamino)-N-(4-phenoxy-phenyl)-nicotinamide**

MS: (ES+) 414 (M + 1)<sup>+</sup>; (ES-): 412 (M - 1)<sup>-</sup>. Calc'd.  
for C<sub>25</sub>H<sub>20</sub>FN<sub>3</sub>O<sub>2</sub> - 413.15.

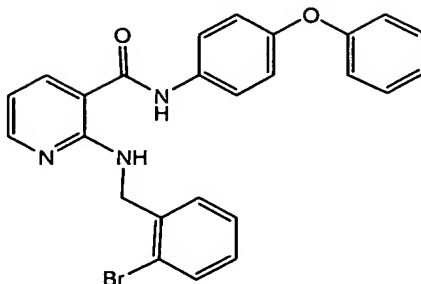
10

**Example 10**15      **N-(4-Phenoxy-phenyl)-2-(4-trifluoromethyl-benzylamino)-  
nicotinamide**

MS: (ES+) 464 (M+1)<sup>+</sup>; (ES-): 462 (M-1)<sup>-</sup>. Calc'd. for  
C<sub>26</sub>H<sub>20</sub>F<sub>3</sub>N<sub>3</sub>O<sub>2</sub> - 463.15.

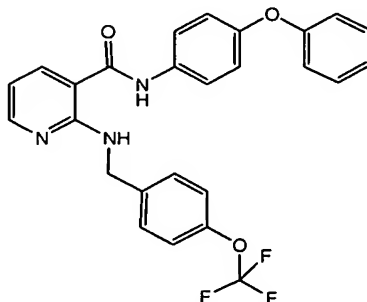
20

E00TFO"255409F

**Example 11****5      2-(2-Bromo-benzylamino)-N-(4-phenoxy-phenyl)-nicotinamide**

MS: (ES+) 475 (M+1)<sup>+</sup>; (ES-): 473 (M-1)<sup>-</sup>. Calc'd. for  
C<sub>25</sub>H<sub>20</sub>BrN<sub>3</sub>O<sub>2</sub> - 473.07.

10

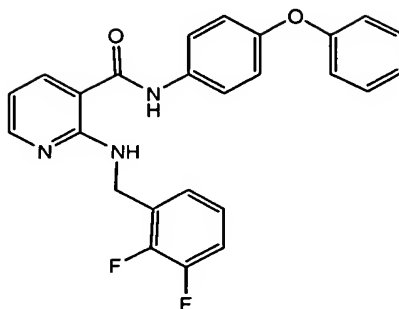
**Example 12****15      N-(4-Phenoxy-phenyl)-2-(4-trifluoromethoxy-benzylamino)-  
nicotinamide**

MS: (ES+) 480 (M+1)<sup>+</sup>; (ES-): 478 (M-1)<sup>-</sup>. Calc'd. for  
C<sub>26</sub>H<sub>20</sub>F<sub>3</sub>N<sub>3</sub>O<sub>3</sub> - 479.15.

20

20250904 14:55:40

## Example 13



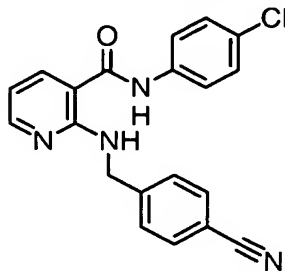
5

**2-(2,3-Difluorobenzylamino)-N-(4-phenoxyphenyl)-nicotinamide**

MS: (ES+) 432 (M+1)<sup>+</sup>; (ES-): 430 (M-1)<sup>-</sup>. Calc'd. for  
C<sub>25</sub>H<sub>19</sub>F<sub>2</sub>N<sub>3</sub>O<sub>2</sub> - 431.14.

10

## Example 14

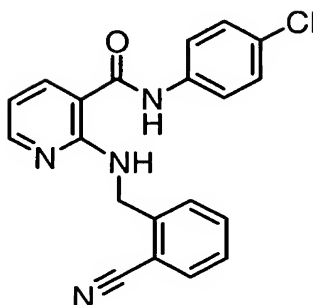
**N-(4-Chlorophenyl)(2-([(4-cyanophenyl)methyl]amino)(3-pyridyl))carboxamide**

15

MS (ES+): 363 (M+H); (ES-): 361 (M-H). Calc'd. for  
C<sub>20</sub>H<sub>15</sub>ClN<sub>4</sub>O - 362.81.

20

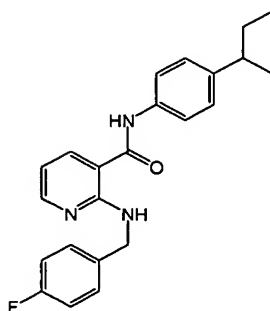


**Example 15**

5

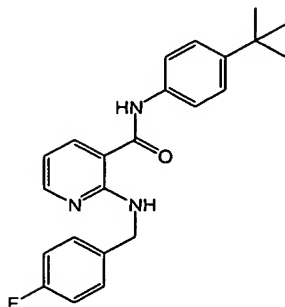
**N-(4-Chlorophenyl)-2-([(2-cyanophenyl)methyl]amino)-3-pyridylcarboxamide**

MS (ES+): 363 (M+H); (ES-): 361 (M-H). Calc'd. for  
10 C<sub>20</sub>H<sub>15</sub>ClN<sub>4</sub>O - 362.81.

**Example 16**

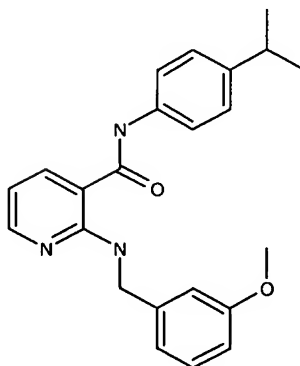
15 **N-(4-sec-butylphenyl)-2-[(4-fluorobenzyl)amino]nicotinamide**

MS: (ES+) 378.2 (M+H); (ES-) 376.2 (M-H). Calc'd for  
20 C<sub>23</sub>H<sub>24</sub>FN<sub>3</sub>O - 377.45.

**Example 17****5 N-(4-tert-Butylphenyl)-2-[(4-fluorobenzyl)amino]nicotinamide**

MS: (ES+) 378.2 (M+H)<sup>+</sup>; (ES-) 376. (M-H)<sup>-</sup>. Calc'd for C<sub>23</sub>H<sub>24</sub>FN<sub>3</sub>O - 377.45.

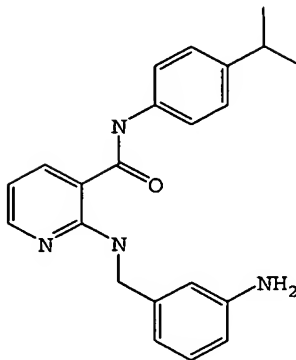
10

**Example 18****N-(4-Isopropyl-phenyl)-2-(3-methoxy-benzylamino)-  
nicotinamide**

15

MS (ES+): 376 (M+H)<sup>+</sup>; (ES-): 374 (M-H)<sup>-</sup>. Calc'd C<sub>23</sub>H<sub>25</sub>N<sub>3</sub>O<sub>2</sub> - 375.47.

## Example 19

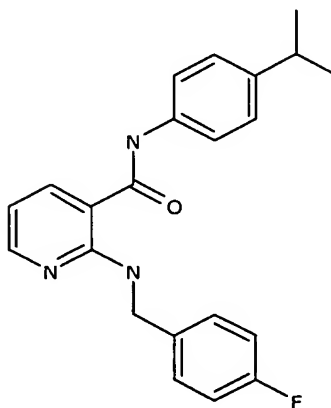


5 (2-(((3-Aminophenyl)methyl)amino)(3-pyridyl))-N-[4-(methylethyl)phenyl]carboxamide

MS (ES+): 361 (M+H)<sup>+</sup>; (ES-): 359 (M-H)<sup>-</sup>. Calc'd C<sub>22</sub>H<sub>24</sub>N<sub>4</sub>O - 360.46.

10

## Example 20

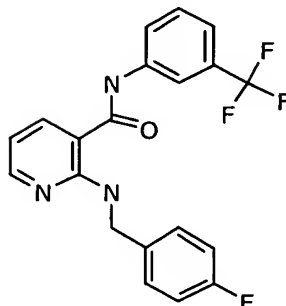


15 (2-(((4-Fluorophenyl)methyl)amino)(3-pyridyl))-N-[4-(methylethyl)phenyl]carboxamide

MS (ES+): 364 (M+H)<sup>+</sup>; (ES-): 362. Calc'd C<sub>22</sub>H<sub>22</sub>FN<sub>3</sub>O - 363.43.

E04F03/03407

## Example 21

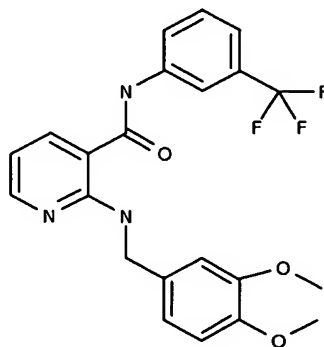


5 (2-([(4-Fluorophenyl)methyl]amino)(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 390 (M+H); (ES-) 388. (M-H). Calc'd for C<sub>20</sub>H<sub>15</sub>F<sub>4</sub>N<sub>3</sub>O  
- 389.35.

10

## Example 22



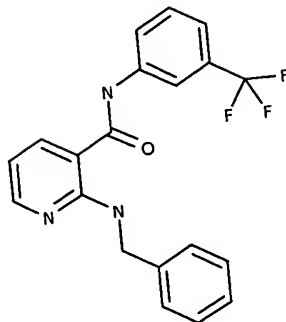
15 (2-([(3,4-Dimethoxyphenyl)methyl]amino)(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 432 (M+H); (ES-) 430. (M-H). Calc'd for  
C<sub>20</sub>H<sub>20</sub>F<sub>3</sub>N<sub>3</sub>O<sub>3</sub>: 431.41.

20

A-735A

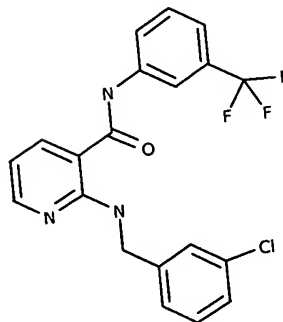
Example 23



5 {2-[Benzylamino] (3-pyridyl)}-N-[3-(trifluoromethyl)  
phenyl]-carboxamide

MS: (ES+) 372 (M+H); (ES-) 370. (M-H). Calc'd for  $C_{20}H_{16}F_3N_3O$ :  
371.36.

10 Example 24

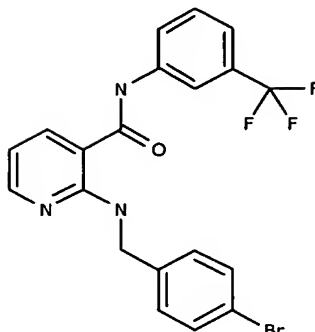


15 (2-[[3-(3-Chlorophenyl)methyl]amino] (3-pyridyl))-N-[3-  
(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 406 (M+H); (ES-) 404. (M-H). Calc'd for  
 $C_{20}H_{15}ClF_3N_3O$ : 405.81.

20

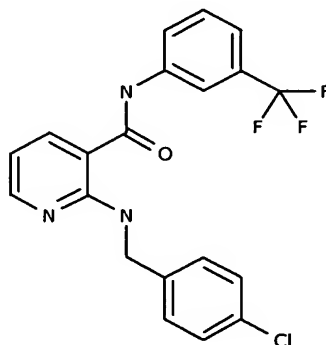
### Example 25



5 (2-{[(4-Bromophenyl)methyl]amino}(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 451 (M+H); (ES-) 449. (M-H). Calc'd for  $C_{20}H_{15}BrF_3N_3O$ : 450.26.

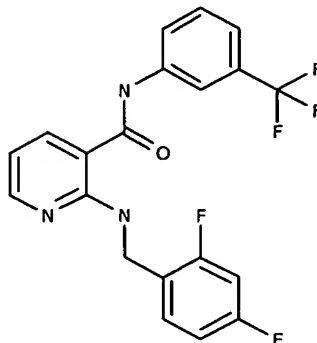
### Example 26



15' (2-[[ (4-Chlorophenyl)methyl]amino] (3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 406 (M+H); (ES-) 404. (M-H). Calc'd for  $C_{20}H_{15}ClF_3N_3O$ : 405.81.

## Example 27

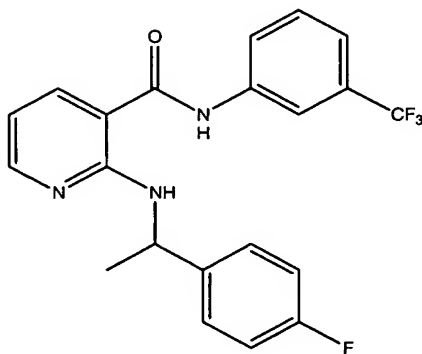


5       (2-((2,4-Difluorophenyl)methyl)amino)(3-pyridyl)-N-[3-  
         (trifluoromethyl)phenyl]carboxamide

MS: (ES+) 408 (M+H); (ES-) 406. (M-H). Calc'd for C<sub>20</sub>H<sub>17</sub>F<sub>5</sub>N<sub>3</sub>O:  
407.34.

10

## Example 28

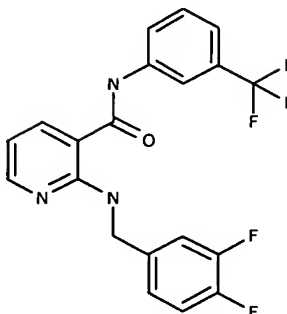


15       2-[1-(4-Fluoro-phenyl)-ethylamino]-N-(3-trifluoromethyl-  
         phenyl)-nicotinamide

MS: (ES+) 404 (M+H); (ES-) 402. (M-H). Calc'd for C<sub>21</sub>H<sub>17</sub>F<sub>4</sub>N<sub>3</sub>O:  
403.37.

20

## Example 29

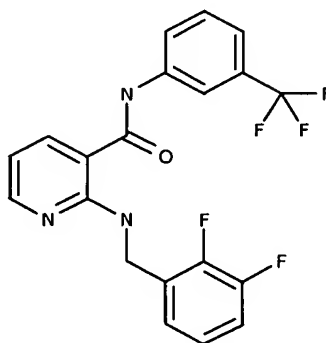


5

(2-([(3,4-Difluorophenyl)methyl]amino)(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

10 MS: (ES+) 408 (M+H); (ES-) 406. (M-H). Calc'd for  $C_{20}H_{14}F_5N_3O$ : 407.34.

## Example 30



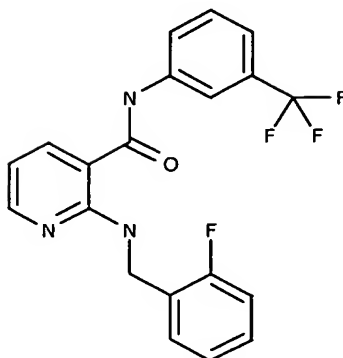
15

(2-([(2,3-Difluorophenyl)methyl]amino)(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

20 MS: (ES+) 408 (M+H); (ES-) 406. (M-H). Calc'd for  $C_{20}H_{14}F_5N_3O$ : 407.34.



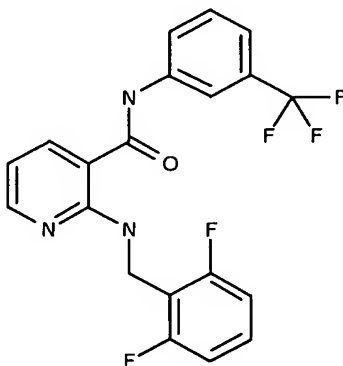
### Example 31



5 (2-{[(2-Fluorophenyl)methyl]amino}(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 390 (M+H); (ES-) 388. (M-H). Calc'd for  $C_{20}H_{15}F_4N_3O$ : 389.35.

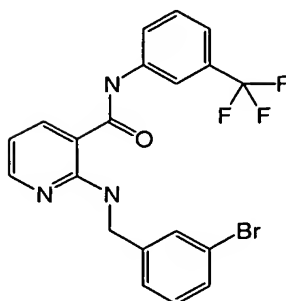
### Example 32



15 (2-[(2,6-Difluorophenyl)methyl]amino)(3-pyridyl))-N-[3-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 408 (M+H); (ES-) 406. (M-H). Calc'd for  $C_{20}H_{14}F_5N_3O$ :  
407.34.

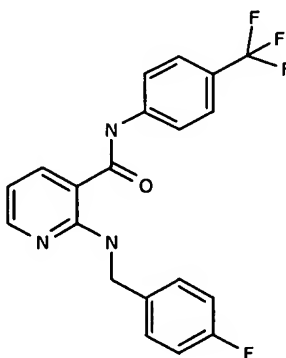
[illegible]

**Example 33**

5

(2-[[ (3-Bromophenyl)methyl]amino] (3-pyridyl)) -N- [3-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 451 (M+H); (ES-) 449. (M-H). Calc'd for  
10 C<sub>20</sub>H<sub>15</sub>BrF<sub>3</sub>N<sub>3</sub>O: 450.26.

**Example 34**

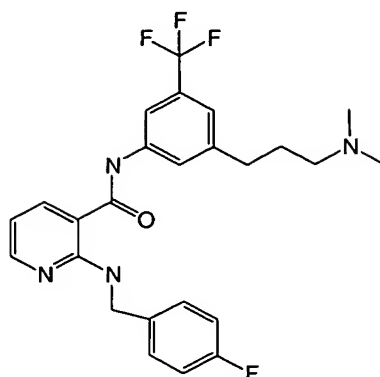
15

(2-[[ (4-Fluorophenyl)methyl]amino] (3-pyridyl)) -N- [4-(trifluoromethyl)phenyl]carboxamide

MS: (ES+) 390 (M+H); (ES-) 388. (M-H). Calc'd for C<sub>20</sub>H<sub>15</sub>F<sub>4</sub>N<sub>3</sub>O:  
389.35.

20

## Example 35



5

**N-{3-[3-(Dimethylamino)propyl]-5-(trifluoromethyl)phenyl}(2-  
[[4-(4-fluorophenyl)methyl]amino](3-pyridyl))carboxamide**

10 **Step A Preparation of {3-[3-amino-5-  
(trifluoromethyl)phenyl]propynyl}dimethylamine**

A mixture of 3-bromo-5-trifluoromethylaniline (1.4 g, 5.9 mmol), 1-dimethylamino-2-propyne (1.3 mL, 0.76 mmol),  $\text{PdCl}_2(\text{PPh}_3)_2$  (0.26 g, 0.29 mmol) and CuI (114 mg, 0.60 mmol) in 10 mL of TEA was heated at 100°C in a sealed tube for 3 h. The resulting mixture was filtered over Celite®. The filtrate was concentrated, and the residue was purified by prep-HPLC (reverse phase) to give the aniline. MS (ES+): 243 (M+H)<sup>+</sup>; (ES-): 241 (M-H)<sup>-</sup>. Calc'd  $\text{C}_{12}\text{H}_{13}\text{F}_3\text{N}_2$  - 242.24.

20 **Step B Preparation of {3-[3-amino-5-  
(trifluoromethyl)phenyl]propyl}dimethylamine**

A mixture of the above aniline (7 g, 29 mmol) and  $\text{Pd}(\text{OH})_2$  (0.5 g) in 250 mL of MeOH was stirred under 50 psi  $\text{H}_2$ . After 2 h, the resulting mixture was filtered over Celite®. The filtrate was concentrated, and the residue was diluted with aq. 1N HCl. The aq. layer was washed with  $\text{Et}_2\text{O}$ , made basic with aq. 5N NaOH, and extracted with  $\text{CH}_2\text{Cl}_2$ . The

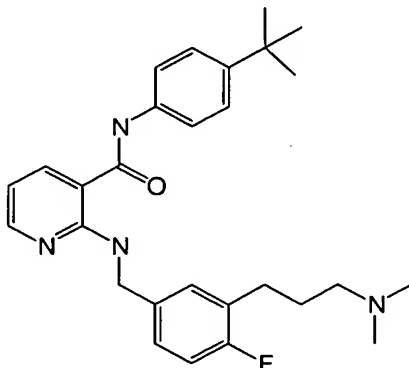
2025 RELEASE UNDER E.O. 14176

organic solution was dried over NaSO<sub>4</sub> and concentrated to give the titled compound. MS (ES<sup>+</sup>): 386 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 384 (M-H)<sup>-</sup>. Calc'd C<sub>18</sub>H<sub>19</sub>ClF<sub>3</sub>N<sub>3</sub>O - 385.81.

5 **Step C Preparation of N-{3-[3-(dimethylamino)propyl]-5-(trifluoromethyl)phenyl}(2-[(4-fluorophenyl)methyl]amino)(3-pyridyl))carboxamide**

The title compound was analogously synthesized by the method described in Example 7. MS (ES<sup>+</sup>): 475 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 473 (M-H)<sup>-</sup>. Calc'd C<sub>25</sub>H<sub>26</sub>F<sub>4</sub>N<sub>4</sub>O - 474.50.

**Example 36**



15 **{2-[(3-[3-(Dimethylamino)propyl]-4-fluorophenyl)methyl]amino}(3-pyridyl))-N-[4-(tert-butyl)phenyl]carboxamide**

**Step A Preparation of N-Boc-(3-bromo-4-fluoro-benzyl)amine**

20 To a solution of 3-bromo-4-fluorobenzylamine hydrochloride (10 g, 42 mmol) and TEA (10.5 g, 103 mmol) in 200 mL of CH<sub>2</sub>Cl<sub>2</sub> was added BOC<sub>2</sub>O (9.1g, 42 mmol) at RT. The resulting solution was stirred for 16 h. The solution was diluted with aq. 1N NaOH and CH<sub>2</sub>Cl<sub>2</sub>. The organic layer was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, and concentrated to give N-Boc-(3-bromo-4-fluoro-benzyl)amine. MS (ES<sup>+</sup>): 305 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 303 (M-H). Calc'd C<sub>12</sub>H<sub>15</sub>BrFNO<sub>2</sub> - 304.16.

**Step B Preparation of [3-(3-dimethylamino-propyl)-4-fluoro-benzyl]-Boc-amine**

[3-(3-Dimethylamino-propyl)-4-fluoro-benzyl]-Boc-amine  
5 was prepared from N-Boc-(3-bromo-4-fluoro-benzyl)amine according to a procedure similar to that described in Example 35, Step A.

**Step C Preparation of N-{3-[3-(dimethylamino)propyl]-4-fluorophenyl}methylaniline**

To [3-(3-Dimethylamino-propyl)-4-fluoro-benzyl]-Boc-amine (3.0 g, 10 mmol) in 100 mL of CH<sub>2</sub>Cl<sub>2</sub> was slowly added TFA (10 mL). The resulting solution was stirred for 1 h, then concentrated. The residue was diluted with CH<sub>2</sub>Cl<sub>2</sub> and  
15 aq. NaHCO<sub>3</sub> solution. The organic layer was dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated to give the title compound. MS (ES<sup>+</sup>): 211 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 209 (M-H). Calc'd C<sub>12</sub>H<sub>19</sub>FN<sub>2</sub> - 210.29.

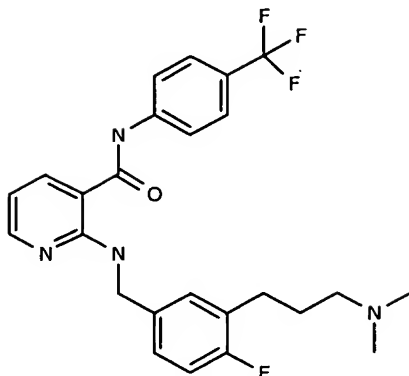
**Step D Preparation of {2-[(3-[3-(dimethylamino)propyl]-4-fluorophenyl)methyl]amino}(3-pyridyl)}-N-[4-(tert-butyl)phenyl]carboxamide**

The title compound was analogously synthesized by the method described in Example 7. MS (ES<sup>+</sup>): 463 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 461 (M-H). Calc'd C<sub>28</sub>H<sub>35</sub>FN<sub>4</sub>O - 462.61.

25

The following compounds were analogously synthesized by the method described in Example 36.

## Exempl 37



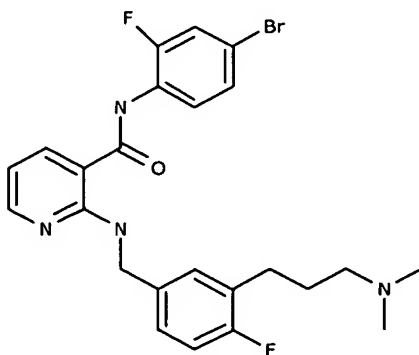
5

{2-[(3-[3-(Dimethylamino)propyl]-4-fluorophenyl)methyl]amino}(3-pyridyl)-N-[4-(trifluoromethyl)phenyl]carboxamide

MS (ES+): 475 (M+H)<sup>+</sup>; (ES-): 473 (M-H). Calc'd

10 C<sub>25</sub>H<sub>26</sub>F<sub>4</sub>N<sub>4</sub>O - 474.50.

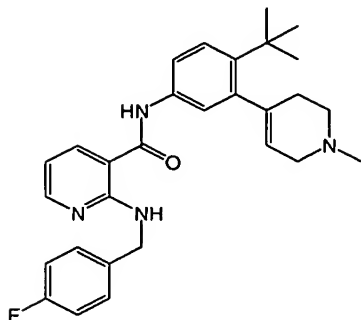
## Example 38



15

{2-[(3-[3-(Dimethylamino)propyl]-4-fluorophenyl)methyl]amino}(3-pyridyl)-N-(4-bromo-2-fluorophenyl)carboxamide

MS (ES<sup>+</sup>): 504 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 502 (M-H)<sup>-</sup>. Calc'd C<sub>24</sub>H<sub>25</sub>BrF<sub>2</sub>N<sub>4</sub>O - 503.39.

**Example 39**

**2-[(4-Fluorobenzyl)amino]-N-[4-tert-butyl-3-(1,2,3,6-tetrahydropyridin-4-yl)phenyl]nicotinamide**

**Step A Preparation of 2-bromo-1-tert-butyl-4-nitrobenzene**

NBS (125.0 g, 697.5 mmol, 1.5 eq) was slowly added to a solution of TFA:H<sub>2</sub>SO<sub>4</sub> (5:1, 750 mL) and tert-butyl-4-nitrobenzene (100.0 g, 558.0 mmol) at RT. The solution was stirred for 24 h then poured over 5 kg of ice. The resulting suspension was filtered, washed with a 1:1 MeOH:H<sub>2</sub>O solution (200 mL) and dried in a vacuum oven. MS (ES<sup>+</sup>): 258.1, 260.1 (M+H)<sup>+</sup>

**Step B Preparation of 4-(2-tert-butyl-5-nitrophenyl)pyridine**

To a solution of 2-bromo-1-tert-butyl-4-nitrobenzene (8.6 g, 33.3 mmol) (Step A) and toluene (70 mL) in a 150 mL round bottom flask, 4-pyridylboronic acid (4.5 g, 36.6 mmol, 1.1 eq), Pd(PPh<sub>3</sub>)<sub>4</sub> (3.8 g, 3.3 mmol, 0.1 eq) and K<sub>2</sub>CO<sub>3</sub> (13.8 g, 99.9 mmol, 3 eq) were added. The solution was stirred for 24 h at 80°C. The solution was filtered through a pad of Celite® and purified by silica flash chromatography (30% Hex/Hex) to afford the desired compound as a yellow solid. MS (ES<sup>+</sup>): 257.2 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 255.2 (M-H)<sup>-</sup>.

**Step C Preparation of 4-(2-tert-butyl-5-nitrophenyl)-1-methylpyridinium**

4-(2-tert-Butyl-5-nitrophenyl)pyridine (2.0 g, 7.8 mmol) (Step B) was added to a round-bottom flask and dissolved in EtOH (10 mL). CH<sub>3</sub>I (30 mL) was added to the flask and heated to reflux. After 6 h, the solution was cooled to RT and concentrated in vacuo resulting in the desired compound as a light brown solid. MS (ES<sup>+</sup>): 271.2 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 269.2 (M-H)<sup>-</sup>. Calc'd for C<sub>16</sub>H<sub>19</sub>N<sub>2</sub>O<sub>2</sub>: 271.14.

**Step D: Preparation of 4-tert-butyl-3-(1-methyl-1,2,3,6-tetrahydropyridin-4-yl)aniline**

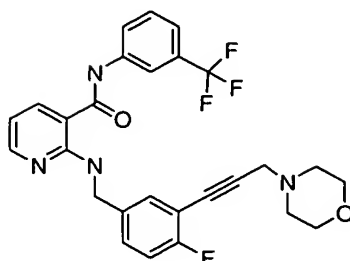
4-(2-tert-Butyl-5-nitrophenyl)-1-methylpyridinium (2.1 g, 7.8 mmol) (Step C) was added to a 100 mL round-bottom flask and dissolved in a 10% H<sub>2</sub>O/EtOH mixture. Iron dust (1.31 g, 23.4 mmol, 3 eq) and NH<sub>4</sub>Cl (460 mg, 8.6 mmol, 1.1 eq) were added. The flask was heated to reflux. After 2 h, the solution was cooled to RT and filtered through a pad of Celite®. The resulting solution was stripped down to a yellow solid and redissolved in MeOH (20 mL, anhydrous). The solution was cooled to 0°C and slowly adding NaBH<sub>4</sub> (450 mg, 11.7 mmol, 1.5 eq). The solution was cooled to RT and stirred for 30 min. The solvent was stripped-off under vacuum and the solid was redissolved in CH<sub>2</sub>Cl<sub>2</sub> and filtered. The solution was concentrated in vacuo to afford an amorphous clear yellow solid. MS (ES<sup>+</sup>): 245.2 (M+H)<sup>+</sup>

**Step E: Preparation of 2-[(4-fluorobenzyl)amino]-N-[4-tert-butyl-3-(1,2,3,6-tetrahydropyridin-4-yl)phenyl]nicotinamide**

The title compound was analogously synthesized by the method described in Example 7. MS: (ES<sup>+</sup>) 473.2 (M+H); (ES<sup>-</sup>) 471.4 (M-H). Calc'd for C<sub>29</sub>H<sub>33</sub>FN<sub>4</sub>O: 472.60.



## Example 40



5

[2-({[4-Fluoro-3-(3-morpholin-4-ylprop-1-ynyl)phenyl]methyl}amino)(3-pyridyl)]-N-[3-(trifluoromethyl)phenyl]carboxamide

10 **Step A: Preparation of (tert-butoxy)-N-[(3-bromo-4-fluorophenyl)methyl] carboxamide**

To a solution of 3-bromo-4-fluorobenzylamine (10 g, 41 mmol) and TEA (14 mL, 104 mmol) in CH<sub>2</sub>Cl<sub>2</sub> was added BOC<sub>2</sub>O (9.1 g, 41 mmol). The resulting solution was stirred for 16 h at RT, then diluted with aq. 1N NaOH and CH<sub>2</sub>Cl<sub>2</sub>. The organic layer was separated, washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, and concentrated to give (tert-butoxy)-N-[(3-bromo-4-fluorophenyl)methyl]carboxamide.

20 **Step B: Preparation of (tert-Butoxy)-N-{[4-fluoro-3-(3-hydroxyprop-1-ynyl)phenyl]methyl}carboxamide**

A mixture of tert-butoxy-N-[(3-bromo-4-fluorophenyl)methyl] carboxamide (0.6 g, 2.0 mmol, Step A), CuI (38 mg, 0.2 mmol), PdCl<sub>2</sub>(PPh<sub>3</sub>)<sub>2</sub> (72 mg, 0.1 mmol), propargyl alcohol (0.35 mL, 6.0 mmol) and TEA (12 mL) was heated at 100°C for 5 h. The resulting mixture was filtered, and the filtrate was concentrated. The residue was purified by SiO<sub>2</sub> chromatography to give the title compound. MS (ES<sup>+</sup>): 297 (M+NH<sub>4</sub>)<sup>+</sup>. Calc'd C<sub>15</sub>H<sub>22</sub>FN<sub>2</sub>O<sub>3</sub> - 297.34.

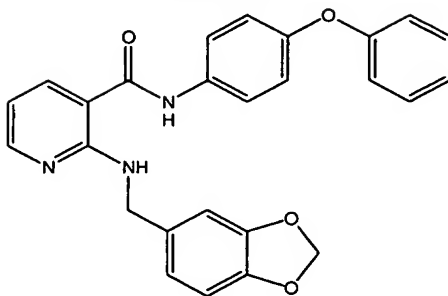
**Step C: Preparation of [4-Fluoro-3-(3-morpholin-4-ylprop-1-ynyl)phenyl]-methylamine**

To a mixture of (tert-butoxy)-N-{{[4-fluoro-3-(3-hydroxyprop-1-ynyl)phenyl]methyl}carboxamide (0.23g, 0.82 mmol) (Step B) and NMO (0.14 g, 1.3 mmol) was added catalytic amount of TPAP. The resulting mixture was stirred for 1 h at RT, then filtered over a short pad of SiO<sub>2</sub> and concentrated. To a solution of the residue and morpholine (0.1 mL, 1.2 mmol) in CH<sub>2</sub>Cl<sub>2</sub> was added excess NaBH(OAc)<sub>3</sub>. The resulting solution was stirred for 16 h, diluted with CH<sub>2</sub>Cl<sub>2</sub> and saturated aq. NaHCO<sub>3</sub> solution. The organic layer was separated, dried over Na<sub>2</sub>SO<sub>4</sub>, and concentrated. The residue was purified by SiO<sub>2</sub> chromatography to give a colorless oil, which was dissolved in 5 mL of CH<sub>2</sub>Cl<sub>2</sub>. To the organic solution was added TFA (2 mL). The resulting solution was stirred for 1 h at RT, then concentrated. The residue was diluted with CH<sub>2</sub>Cl<sub>2</sub> and saturated aq. NaHCO<sub>3</sub> solution. The organic layer was separated, dried over Na<sub>2</sub>SO<sub>4</sub>, and concentrated to give the title compound. MS (ES<sup>+</sup>): 249 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 247. Calc'd C<sub>14</sub>H<sub>17</sub>FN<sub>2</sub>O - 248.30.

**Step D: Preparation of [2-({[4-fluoro-3-(3-morpholin-4-ylprop-1-ynyl)phenyl]methyl}amino)(3-pyridyl)]-N-[3-(trifluoromethyl)phenyl]carboxamide**

The title compound was analogously synthesized by the method described in Example 7. MS (ES<sup>+</sup>): 513 (M+H)<sup>+</sup>; (ES<sup>-</sup>): 511. Calc'd C<sub>27</sub>H<sub>24</sub>F<sub>4</sub>N<sub>4</sub>O<sub>2</sub> - 512.51.

## Example 41

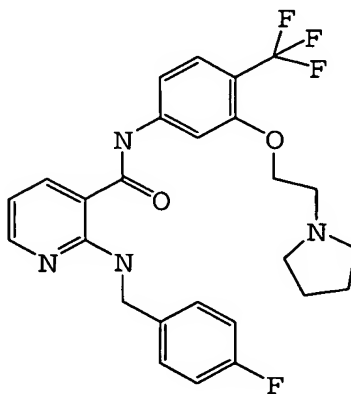


5                   **{2-[(2H-Benzo[d]1,3-dioxol-5-ylmethyl)**  
                  **amino](3-pyridyl)}-N-(4-phenoxyphenyl)carboxamide:**

2-Chloro-(3-pyridyl)-N-(4-phenoxyphenyl)-carboxamide  
(0.500 g, 1.5 mmol) and 2H-benzo[d]1,3-dioxolan-5-  
10 ylmethylamine (0.680 g, 4.5 mmol) were combined and heated  
neat at 110°C for 18 h. After cooling to RT, the resulting  
residue was dissolved in EtOAc and washed with saturated  
NaCO<sub>3</sub> solution and brine, respectively. The organics were  
dried over Na<sub>2</sub>SO<sub>4</sub> and evaporated. The crude material was  
15 purified by column chromatography with EtOAc/hexanes (1:2)  
as eluant to leave the desired compound as an off-white  
solid. MS: (ES+) 440 (M + 1)<sup>+</sup>; (ES-): 438 (M - 1)<sup>-</sup>. Calc'd.  
for C<sub>26</sub>H<sub>21</sub>N<sub>3</sub>O<sub>4</sub> - 439.15.

20

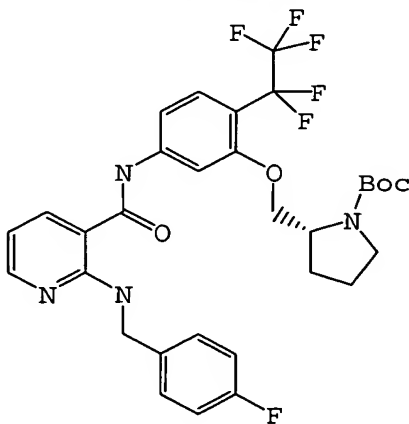
## Example 42



**2-(4-Fluoro-benzylamino)-N-[3-(2-pyrrolidin-1-yl-ethoxy)-4-trifluoromethyl-phenyl]-nicotinamide**

5        2-Chloro-N-[3-(2-pyrrolidin-1-yl-ethoxy)-4-trifluoromethyl-phenyl]-nicotinamide (199.1 mg), DIEA (252 uL) and 4-fluorobenzylamine (193 uL) were combined in a sealed tube and heated to 130°C for 2 h. The mixture was purified on silica gel chromatography (2-3.5% MeOH/CH<sub>2</sub>Cl<sub>2</sub>).  
10    The desired fractions were concentrated *in vacuo*, and the residue was dissolved in Et<sub>2</sub>O and hexanes were added until the solution became cloudy. The solids were filtered, and dried. Additional material was obtained from the filtrate upon additional rounds of concentration, dissolving in Et<sub>2</sub>O  
15    and treatment with hexanes. M+H 503.4, Calc'd 502.2.

**Example 43**

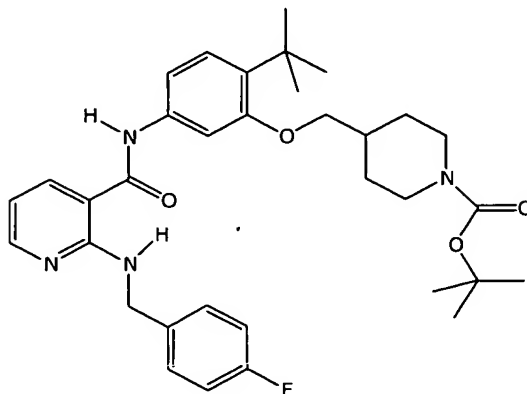


20        **(R) 2-(4-Fluoro-benzylamino)-N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide**

25        2-Chloro-N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide (442.8 mg) DIEA (351 uL) and 4-fluorobenzylamine (322 uL) were combined in a sealed tube and heated to 130°C for 3 h. The mixture was diluted with EtOAc and H<sub>2</sub>O, the layers were separated and the organic layer was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>,

filtered and concentrated in vacuo. The residue was purified with silica gel chromatography (1% MeOH/CH<sub>2</sub>Cl<sub>2</sub>) to obtain an off-white solid.

5

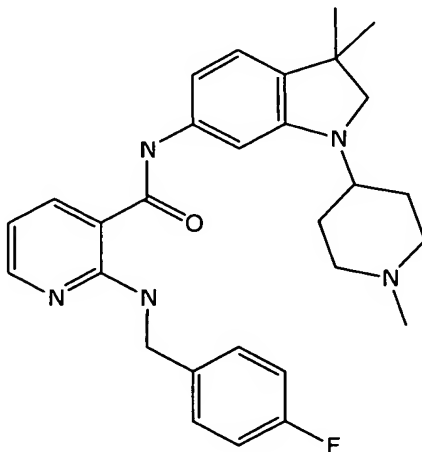
**Example 44**

**N-[4-tert-Butyl-3-(1-Boc-piperidin-4-ylmethoxy)-phenyl]-2-(4-fluorobenzylamino)-nicotinamide**

10

N-[4-tert-Butyl-3-(1-Boc-piperidin-4-ylmethoxy)-phenyl]-2-chloro-nicotinamide (200 mg), DIEA (145 uL), IpOH (3 ml) and 4-fluorobenzylamine (184 uL) were combined in a sealed tube and heated to 125C for 2 days. The mixture was purified by flash chromatography (EtOAc) to provide the product. M+Na 619; Calc'd for C<sub>34</sub>H<sub>43</sub>FN<sub>4</sub>O<sub>4</sub>: 590.33.

15

**Example 45**

**N-[3,3-Dimethyl-1-(1-methyl-piperidin-4-yl)-2,3-dihydro-1H-indol-6-yl]-2-(4-fluoro-benzylamino)-nicotinamide**

5

A solution of N-[3,3-dimethyl-1-(1-methyl-piperidin-4-yl)-2,3-dihydro-1H-indol-6-yl]-2-fluoro-nicotinamide (500 mg), 4-fluorobenzylamine (240 uL) and NaHCO<sub>3</sub> (359 mg) was dissolved in IpOH (5 ml) and heated to 85C overnight. After  
10 cooling to RT, the mixture was dried under N<sub>2</sub>. The residue was partitioned between EtOAc and H<sub>2</sub>O, the organic layer was separated, washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub> and filtered. Silica was added to the filtrate and concentrated to a residue. It was purified by flash chromatography (10%  
15 MeOH/EtOAc) to yield a fluffy yellow solid. M+H 488.4. Calc'd for C<sub>29</sub>H<sub>34</sub>FN<sub>5</sub>O: 487.3.

The following compounds (Examples 46-53) were analogously formed from the corresponding fluoro compounds  
20 by the method described in Example 45.

46) N-[1-(2-Dimethylamino-acetyl)-3,3-dimethyl-2,3-dihydro-1H-indol-6-yl]-2-(4-fluoro-benzylamino)-nicotinamide. M+H 476.3; Calc'd 475.24.

25

47) N-[1-(1-Boc-piperidin-4-yl)-3,3-dimethyl-2,3-dihydro-1H-indol-6-yl]-2-(4-fluoro-benzylamino)-nicotinamide. M+H 574.5; Calc'd 573.31.

30 48) N-[3,3-Dimethyl-1-(2-Boc-amino-acetyl)-2,3-dihydro-1H-indol-6-yl]-2-(4-fluoro-benzylamino)-nicotinamide. M+H 548.4.

49) 2-(4-Fluoro-benzylamino)-N-(2-Boc-4,4-dimethyl-1,2,3,4-tetrahydro-isoquinolin-7-yl)-nicotinamide. M+H 505.4.  
35

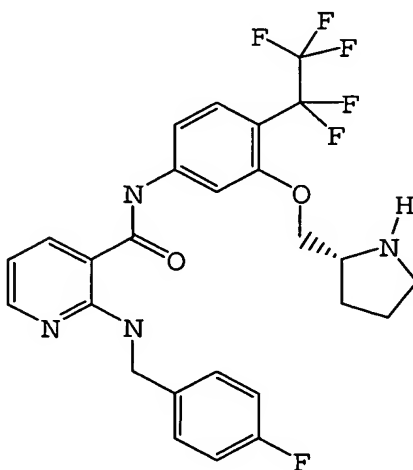
50) N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-2-(4-fluoro-benzylamino)-nicotinamide was prepared as above but at 90C overnight and with a second addition of  
5 amine prior to heating for another 24 h. M+Na 611. Calc'd 588.2.

51) N-[4-tert-Butyl-3-(1-Boc-pyrrolidin-2-ylmethoxy)-phenyl]-2-(4-fluoro-benzylamino)-nicotinamide. M+Na 599.  
10 Calc'd 576.31.

52) N-(4-Acetyl-2,2-dimethyl-3,4-dihydro-2H-benzo[1,4]oxazin-6-yl)-2-(4-fluoro-benzylamino)-nicotinamide was prepared as described above but substituting t-BuOH for  
15 IpOH and heating overnight at 80C. M+H 449.1; Calc'd 448.19.

53) 2-(4-Fluoro-benzylamino)-N-[3-(1-Boc-piperidin-4-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide. M+H  
20 603.4.

#### Example 54



(R) 2-(4-Fluoro-benzylamino)-N-[3-(pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide

2-(4-Fluoro-benzylamino)-N-[3-(1-Boc-pyrrolidin-2-ylmethoxy)-4-pentafluoroethyl-phenyl]-nicotinamide (Example 43) was dissolved in  $\text{CH}_2\text{Cl}_2$  (8 ml) and TFA (8 ml) was added. After stirring at RT for 70 min, the mixture was concentrated in vacuo, diluted with 2N NaOH and  $\text{CH}_2\text{Cl}_2$ . The layers were separated and the aqueous layer was back extracted with  $\text{CH}_2\text{Cl}_2$ . The organic layer was washed with brine, dried over  $\text{Na}_2\text{SO}_4$ , filtered and concentrated in vacuo to provide a light pink-orange solid. M+H 539.5. Calc'd for  $\text{C}_{26}\text{H}_{24}\text{F}_6\text{N}_4\text{O}_2$ : 538.2.

The following compounds (Examples 55-59) were analogously formed from the corresponding Boc-protected compounds by the method described in Example 54.

55) (R) 2-(4-Fluoro-benzylamino)-N-[3-(pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide. M+H 489; Calc'd 488.2.

56) N-[4-tert-Butyl-3-(piperidin-4-ylmethoxy)-phenyl]-2-(4-fluoro-benzylamino)-nicotinamide. M+H 491; Calc'd 490.3.

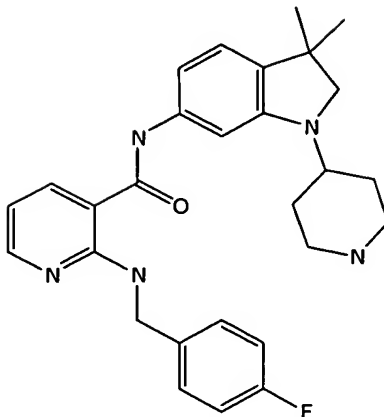
57) (R) N-[4-tert-Butyl-3-(pyrrolidin-2-ylmethoxy)-phenyl]-2-(4-fluoro-benzylamino)-nicotinamide. M+H 477; Calc'd 476.3.

58) N-(4,4-Dimethyl-1,2,3,4-tetrahydro-isoquinolin-7-yl)-2-(4-fluoro-benzylamino)-nicotinamide. M+H 405.1; Calc'd 404.2.

59) N-[1-(2-Amino-acetyl)-3,3-dimethyl-2,3-dihydro-1H-indol-6-yl]-2-(4-fluoro-benzylamino)-nicotinamide.



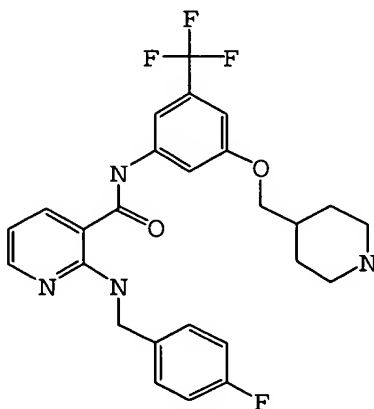
## Example 60



5    **N-(3,3-Dimethyl-1-piperidin-4-yl)-2,3-dihydro-1H-indol-6-yl)-**  
      **2-(4-fluorobenzylamino)-nicotinamide**

      N-[1-(1-Boc-piperidin-4-yl)-3,3-dimethyl-2,3-dihydro-  
1H-indol-6-yl]-2-(4-fluorobenzylamino)-nicotinamide  
10    (Example 47) was dissolved in a mixture of conc. HCl and  
      EtOAc and stirred at RT for 1.5 h. The mixture was  
      concentrated *in vacuo* and the residue was partitioned  
      between EtOAc and 1N NaOH. The organic layer was removed,  
      washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and  
15    concentrated *in vacuo* to provide a yellow solid. M+H 474.3.  
      Calc'd for C<sub>28</sub>H<sub>32</sub>FN<sub>5</sub>O: 473.3.

## Example 61

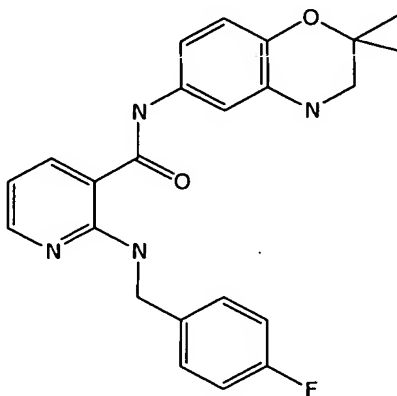


**2-(4-Fluoro-benzylamino)-N-[3-(piperidin-4-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide**

5            2-(4-Fluoro-benzylamino)-N-[3-(piperidin-4-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide was prepared by a method similar to that described for Example 60. M+H 503.3. Calc'd for  $C_{26}H_{26}F_4N_4O_2$ : 502.2.

10

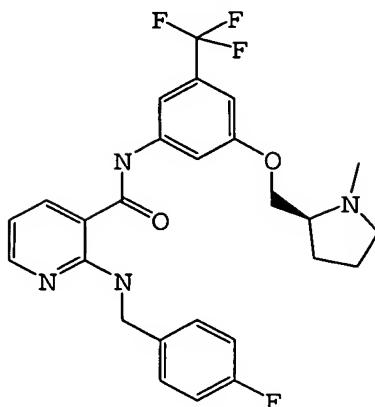
**Example 62**



15

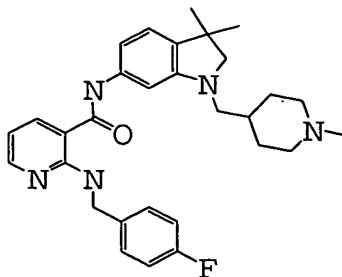
**N-(2,2-Dimethyl-3,4-dihydro-2H-benzo[1,4]oxazin-6-yl)-2-(4-fluoro-benzylamino)-nicotinamide**

N-(4-Acetyl-2,2-dimethyl-3,4-dihydro-2H-benzo[1,4]oxazin-6-yl)-2-(4-fluoro-benzylamino)-nicotinamide (250 mg, Example 52) was dissolved in EtOH (10 ml) and treated with conc. HCL (0.5 ml) at 60°C for 16 h. The mixture was cooled to 0°C and sat. NaHCO<sub>3</sub> (aq) was added. The mixture was extracted with EtOAc (3x50 ml) and the combined organic fractions were washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo. The residue was purified by silica gel chromatography (50% EtOAc/hexanes). M+H 407.3; Calc'd for  $C_{23}H_{23}FN_4O_2$ : 406.18.

**Example 63**

5      **(S)-2-(4-Fluoro-benzylamino)-N-[3-(1-methyl-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide**

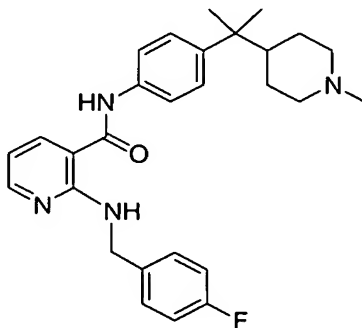
2-Fluoro-N-[3-(1-methyl-pyrrolidin-2-ylmethoxy)-5-trifluoromethyl-phenyl]-nicotinamide (300 mg), TEA (314 uL) and 4-fluorobenzylamine (170 uL) were combined in a sealed  
 10 tube and heated to 90°C for 3 h. Cooled to RT and the mixture was diluted with EtOAc, washed with sat. NH<sub>4</sub>Cl (2x), brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated in vacuo. The residue was purified by silica gel chromatography (CH<sub>2</sub>Cl<sub>2</sub>/MeOH/NH<sub>4</sub>OH 95/5/0.5) to provide an off-white foam  
 15 upon drying. M+H 503. Calc'd for C<sub>26</sub>H<sub>26</sub>F<sub>4</sub>N<sub>4</sub>O<sub>2</sub>: 502.20.

**Example 64**

20      **N-[3,3-Dimethyl-1-(1-methyl-piperidin-4-ylmethyl)-2,3-dihydro-1H-indol-6-yl]-2-(4-fluoro-benzylamino)-nicotinamide**

To N-(3,3-dimethyl-1-piperidin-4-ylmethyl-2,3-dihydro-1H-indol-6-yl)-2-(4-fluoro-benzylamino)-nicotinamide (0.92 g) dissolved in DCE (20 ml) at RT was added formaldehyde (37% aqueous, 0.42 mL) followed by NaBH(OAc)<sub>3</sub> (1.59 g).  
5 After 4 h, the mixture was quenched with 1N HCl (20 mL) and H<sub>2</sub>O (20 mL). It was basified with sat NaHCO<sub>3</sub>, extracted with CH<sub>2</sub>Cl<sub>2</sub> (3x50 mL) and the combined extracts were washed with brine, dried (K<sub>2</sub>CO<sub>3</sub>) and concentrated onto SiO<sub>2</sub> (previously treated with 10% MeOH (2M NH<sub>3</sub> in MeOH/CH<sub>2</sub>Cl<sub>2</sub> and  
10 then concentrated in vacuo). The residue was purified by flash chromatography (Isco, 35g column, 1-7% MeOH (2M NH<sub>3</sub> in MeOH/CH<sub>2</sub>Cl<sub>2</sub>). The bulk of the crude yellow material was further purified by reverse phase Prep HPLC. The isolated fractions were partially concentrated and basified with 1N  
15 NaOH and dried under vacuum to afford a slightly yellow powder. M+H=502.3. Calc'd for C<sub>30</sub>H<sub>36</sub>FN<sub>5</sub>O: 501.29.

#### Example 65



#### 2-(4-Fluoro-benzylamino)-N-{4-[1-methyl-1-(1-methyl-piperidin-4-yl)-ethyl]-phenyl}-nicotinamide

25 A solution of 2-fluoro-N-{4-[1-methyl-1-(1-methyl-piperidin-4-yl)-ethyl]-phenyl}-nicotinamide (355 mg) and 4-fluorobenzylamine (250 mg) in pyridine (10 mL) was suspended with NaHCO<sub>3</sub> (1 g). The mixture was heated to 105°C overnight. Solids were removed by filtration and the

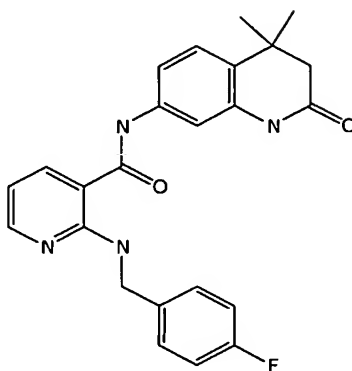
A-735A

- 201 -

filtrate was concentrated in vacuo. The residue was purified on prep. TLC plates (silica, EtOAc:TEA=10:1) to provide the desired product. MS (ES+): 461 (M+1)+, Calc'd for  $C_{28}H_{33}FN_4O$  - 460.59.

5

#### Example 66



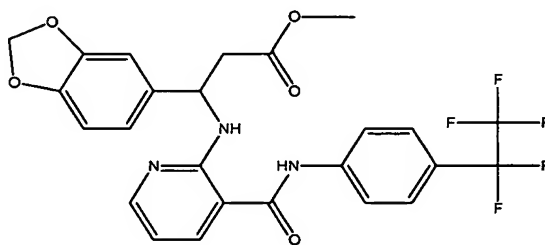
10

**N-(4,4-Dimethyl-2-oxo-1,2,3,4-tetrahydro-quinolin-7-yl)-2-(4-fluorobenzylamino)-nicotinamide**

M+H 419.1. Calc'd for  $C_{24}H_{23}FN_4O_2$ : 418.2.8

15

#### Example 67



20

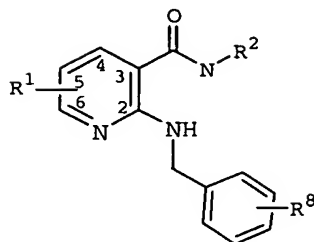
**3-Benzo[1,3]dioxol-5-yl-3-[3-(4-pentafluoroethylphenylcarbamoyl)-pyridin-2-ylamino]-propionic acid**

The Compound was synthesized by a procedure similar to the method described in Example 45. M+H 524.1. Calc'd for  $C_{25}H_{20}F_5N_3O_5$ : 537.13.

- 5 Other compounds included in this invention are set forth in Tables 1-3 below.

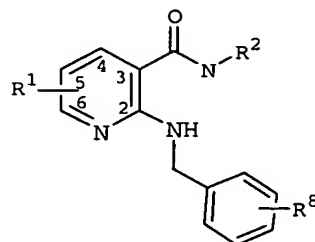
2007-09-25 10:40:00

Table 1.



5	#	$R^1$	$R^2$	$R^8$
	68.	4-chlorophenyl	H	4-amino-
	69.	3-isoquinoliny	H	
	70.	2-quinoliny	H	
10	71.	2-benzthiazolyl	H	
	72.	2-benzimidazolyl	H	4-amino-
	73.	4-benzimidazolyl	H	
	74.	5-benzimidazolyl	H	
	75.	6-benzimidazolyl	H	
15	76.	7-benzimidazolyl	H	
	77.	2-chlorophenyl	5-Br	
	78.	3-isoquinoliny	5-Br	
	79.	2-quinoliny	5-Br	
	80.	2-benzthiazolyl	5-Br	
20	81.	2-benzimidazolyl	5-Br	
	82.	4-benzimidazolyl	5-Br	
	83.	5-benzimidazolyl	5-Br	
	84.	6-benzimidazolyl	5-Br	4-amino-
	85.	7-benzimidazolyl	5-Br	4-amino-
25	86.	4-chlorophenyl	5-Br	3-amino
	87.	4-chlorophenyl	5-Br	4-hydroxy
	88.	4-chlorophenyl	6-CH <sub>3</sub>	4-amino-

Table 1. (cont.)

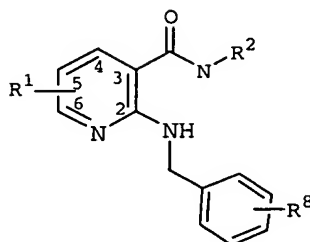


5	#	R <sup>2</sup>	R <sup>1</sup>	R <sup>8</sup>
	89.	4-phenoxyphenyl	H	4-amino
	90.	3-phenoxyphenyl	H	4-methoxy
	91.	4-biphenyl	H	4-methoxy
	92.	4-cyclohexylphenyl	H	4-methoxy
10	93.	2-quinolyl	H	4-methoxy
	94.	3-isoquinolyl	H	4-methoxy
	95.	3-quinolyl	H	4-methoxy
	96.	1-isoquinolyl	H	4-methoxy
	97.	5-quinolyl	H	4-methoxy
15	98.	5-isoquinolyl	H	4-methoxy
	99.	6-quinolyl	H	4-methoxy
	100.	6-isoquinolyl	H	4-methoxy
	101.	7-quinolyl	H	4-methoxy
	102.	7-isoquinolyl	H	4-hydroxy
20	103.	4-quinolyl	H	4-hydroxy
	104.	4-isoquinolyl	H	4-hydroxy
	105.	4-pyridyl	H	4-hydroxy
	106.	4-pyrimidinyl	H	4-hydroxy
	107.	2-pyrimidinyl	H	4-hydroxy
25	108.	6-pyrimidinyl	H	4-hydroxy
	109.	4-pyridazinyl	H	4-hydroxy
	110.	5-pyridazinyl	H	4-hydroxy
	111.	4-indolyl	H	4-hydroxy
	112.	5-isoindolyl	H	3-amino
30	113.	5-naphthyridinyl	H	3-amino
	114.	6-quinozaliny	H	3-amino

2025 RELEASE UNDER E.O. 14176



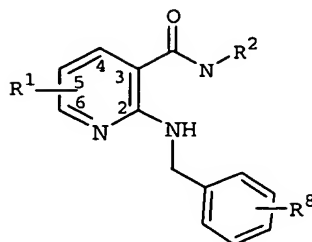
Table 1. (cont.)



5	#	R <sup>2</sup>	R <sup>1</sup>	R <sup>8</sup>
	115.	6-isoquinolyl	H	3-amino
	116.	4-naphthyridinyl	H	3-amino
	117.	5-quinozalinyl	H	3-amino
	118.	4-naphthyridinyl	H	3-amino
10	119.	3,4-dichlorophenyl	H	2-cyano
	120.	6-isoquinolyl	H	2-cyano
	121.	4-chlorophenyl	H	3-cyano
	122.	4-chlorophenyl	H	4-cyano
	123.	6-indazolyl	H	3-hydroxymethyl
15	124.	6-isoindolyl	H	3-hydroxymethyl
	125.	5-indazolyl	H	3-hydroxymethyl
	126.	5-isoindolyl	H	3-hydroxymethyl
	127.	6-benzothienyl	H	3-hydroxymethyl
	128.	6-benzofuryl	H	3-hydroxymethyl
20	129.	5-benzothienyl	H	3-hydroxymethyl
	130.	5-benzofuryl	H	3-hydroxymethyl
	131.	2-benzimidazolyl	H	3-hydroxymethyl
	132.	2-benzoxazolyl	H	3-hydroxymethyl
	133.	6-benzimidazolyl	H	3-hydroxymethyl
25	134.	6-benzoxazolyl	H	3-hydroxymethyl
	135.	6-benzthiazolyl	H	4-amino
	136.	2-quinazolinyl	H	4-hydroxymethyl
	137.	3-(phenoxy)-6-pyridyl	H	3-aminocarbonyl
	138.	4-(phenylcarbonyl)phenyl	H	3-aminocarbonyl

2007-07-25 10:00

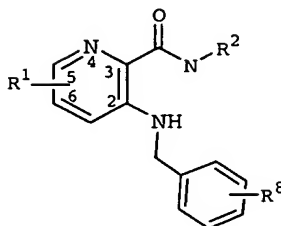
Table 1. (cont.)



5	#	R <sup>2</sup>	R <sup>1</sup>	R <sup>8</sup>
	139.	4-(phenylamino)phenyl	H	3-aminocarbonyl
	140.	4-cyclohexyloxyphenyl	H	3-aminocarbonyl
	141.	4-(3-thienyl)phenyl	H	4-amino
	142.	4-(pyrazol-3-yl)phenyl	H	4-amino
10	143.	4-pyridyl	6-Cl	4-amino, 3-F
	144.	3-methoxyphenyl	6-Cl	4-amino, 3-F
	145.	4-hydroxyphenyl	6-Cl	4-amino, 3-F
	146.	3-hydroxyphenyl	H	4-methoxy, 3-F
	147.	2-hydroxyphenyl	H	3-methoxy, 3-F
15	148.	4-chlorophenyl	6-phenyl	4-amino
	149.	4-phenoxyphenyl	6-phenyl	4-amino
	150.	4-biphenyl	6-phenyl	4-amino
	151.	4-hydroxyphenyl	6-phenyl	4-amino
	152.	4-cyclohexylphenyl	6-phenyl	4-amino
20	153.	3-isoquinolyl	6-phenyl	4-amino

20250709 09:54:00

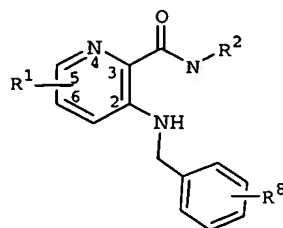
Table 2.



5	#	R <sup>8</sup>	R <sup>2</sup>	R <sup>1</sup>
	154.	4-amino-	4-chlorophenyl	H
	155.	4-amino-	3-isoquinoliny1	H
	156.	4-amino-	2-quinoliny1	H
	157.	4-amino-	2-benzthiazoly1	H
10	158.	4-amino-	2-benzimidazoly1	H
	159.	4-amino-	4-benzimidazoly1	H
	160.	4-amino-	5-benzimidazoly1	H
	161.	4-amino-	6-benzimidazoly1	H
	162.	4-amino-	7-benzimidazoly1	H
15	163.	4-amino-	2-chlorophenyl	5-Br
	164.	4-amino-	3-isoquinoliny1	5-Br
	165.	4-amino-	2-quinoliny1	5-Br
	166.	4-amino-	2-benzthiazoly1	5-Br
	167.	4-amino-	2-benzimidazoly1	5-Br
20	168.	4-amino-	4-benzimidazoly1	5-Br
	169.	4-amino-	5-benzimidazoly1	5-Br
	170.	4-amino-	6-benzimidazoly1	5-Br
	171.	4-amino-	7-benzimidazoly1	5-Br
	172.	3-amino-	4-chlorophenyl	5-Br
25	173.	4-hydroxy-	4-chlorophenyl	5-Br
	174.	4-amino-	4-chlorophenyl	6-CH <sub>3</sub>

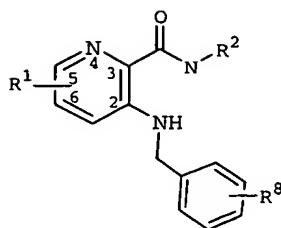
2025-04-04 10:53:40

Table 2. (cont.)



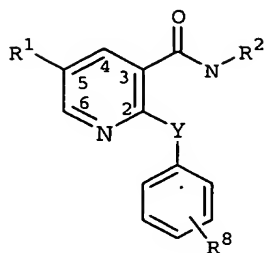
5	#	R <sup>2</sup>	R <sup>1</sup>	R <sup>8</sup>
	175.	4-phenoxyphenyl	H	4-amino
	176.	3-phenoxyphenyl	H	4-methoxy
	177.	biphenyl	H	4-methoxy
	178.	4-cyclohexylphenyl	H	4-methoxy
10	179.	2-quinolyl	H	4-methoxy
	180.	3-isoquinolyl	H	4-methoxy
	181.	3-quinolyl	H	4-methoxy
	182.	1-isoquinolyl	H	4-methoxy
	183.	5-quinolyl	H	4-methoxy
15	184.	5-isoquinolyl	H	4-methoxy
	185.	6-quinolyl	H	4-methoxy
	186.	6-isoquinolyl	H	4-methoxy
	187.	7-quinolyl	H	4-methoxy
	188.	7-isoquinolyl	H	4-hydroxy
20	189.	4-quinolyl	H	4-hydroxy
	190.	4-isoquinolyl	H	4-hydroxy
	191.	4-pyridyl	H	4-hydroxy
	192.	4-pyrimidinyl	H	4-hydroxy
	193.	2-pyrimidinyl	H	4-hydroxy
25	194.	6-pyrimidinyl	H	4-hydroxy
	195.	4-pyridazinyl	H	4-hydroxy
	196.	5-pyridazinyl	H	4-hydroxy
	197.	4-indolyl	H	4-hydroxy
	198.	5-isoindolyl	H	3-amino
30	199.	5-naphthyridinyl	H	3-amino
	200.	6-quinozalinalyl	H	3-amino

Table 2. (cont.)



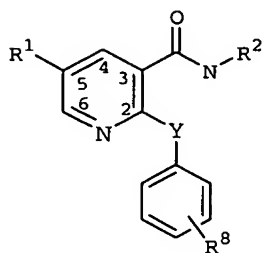
5	#	R <sup>2</sup>	R <sup>1</sup>	R <sup>8</sup>
	201.	6-isoquinolyl	H	3-amino
	202.	4-naphthyridinyl	H	3-amino
	203.	5-quinozaliny	H	3-amino
	204.	4-naphthyridinyl	H	3-amino
10	205.	6-indazolyl	H	3-hydroxymethyl
	206.	6-isoindolyl	H	3-hydroxymethyl
	207.	5-indazolyl	H	3-hydroxymethyl
	208.	5-isoindolyl	H	3-hydroxymethyl
	209.	6-benzothienyl	H	3-hydroxymethyl
15	210.	6-benzofuryl	H	3-hydroxymethyl
	211.	5-benzothienyl	H	3-hydroxymethyl
	212.	5-benzofuryl	H	3-hydroxymethyl
	213.	2-benzimidazolyl	H	3-hydroxymethyl
	214.	2-benzoxazolyl	H	3-hydroxymethyl
20	215.	2-benzthiazolyl	H	3-hydroxymethyl
	216.	6-benzimidazolyl	H	3-hydroxymethyl
	217.	6-benzoxazolyl	H	3-hydroxymethyl
	218.	6-benzthiazolyl	H	4-amino
	219.	2-quinazolinyl	H	4-hydroxymethyl
25				

Table 3.



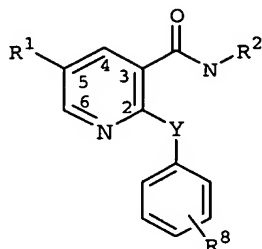
5	#	R <sup>8</sup>	Y	R <sup>2</sup>	R <sup>1</sup>
10	220.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	4-chlorophenyl	H
	221.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	4-chlorophenyl	5-Br
	222.	3,4-diF	-NH <sub>2</sub> SO <sub>2</sub> -	3-chlorophenyl	H
	223.	4-Cl	-NH <sub>2</sub> SO <sub>2</sub> -	3-chlorophenyl	5-Br
	224.	H	-NH <sub>2</sub> SO <sub>2</sub> -	4-phenoxyphenyl	H
	225.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	4-biphenyl	H
	226.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	3-isoquinolyl	H
15	227.	3,4-diF	-NH <sub>2</sub> SO <sub>2</sub> -	3-isoquinolyl	5-Br
	228.	H	-NH <sub>2</sub> SO <sub>2</sub> -	4-chlorophenyl	H
	229.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	4-chlorophenyl	5-Br
	230.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	3-chlorophenyl	H
	231.	3,4-diF	-NH <sub>2</sub> SO <sub>2</sub> -	3-chlorophenyl	5-Br
	232.	H	-NH <sub>2</sub> SO <sub>2</sub> -	4-phenoxyphenyl	H
20	233.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	4-biphenyl	H
	234.	4-F	-NH <sub>2</sub> SO <sub>2</sub> -	3-isoquinolyl	H
	235.	3,4-diF	-NH <sub>2</sub> SO <sub>2</sub> -	3-isoquinolyl	5-Br
	236.	H	-NHCH <sub>2</sub> -		H
	237.	4-F	-NHCH <sub>2</sub> -		H

Table 3. cont.



5	#	R <sup>8</sup>	Y	R <sup>2</sup>	R <sup>1</sup>
	238.	4-F	-NHCH <sub>2</sub> -		H
	239.	4-F	-NHCH <sub>2</sub> -		H
	240.	4-F	-NHCH <sub>2</sub> -	3-CF <sub>3</sub> -phenyl	F
	241.	4-F	-NHCH <sub>2</sub> -		H
10	242.	4-F	-NHCH <sub>2</sub> -		H
	243.	3,4-diF	-NHCH <sub>2</sub> -		H
	244.	H	-NHCH <sub>2</sub> -		H
	245.	4-F	-NHCH <sub>2</sub> -		H

Table 3. cont.

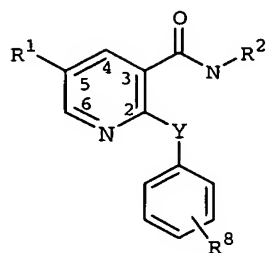


5	#	R <sup>8</sup>	Y	R <sup>2</sup>	R <sup>1</sup>
	246.	4-F	-NHCH <sub>2</sub> -		H
	247.	4-F	-NHCH <sub>2</sub> -		H
	248.	3,4-diF	-NHCH <sub>2</sub> -		H
	249.	H	-NHCH <sub>2</sub> -		H
10	250.	4-F	-NHCH <sub>2</sub> -		H
	251.	4-F	-NHCH <sub>2</sub> -		H
	252.	3,4-diF	-NHCH <sub>2</sub> -		H
	253.	H	-NHCH <sub>2</sub> -		H
	254.	4-F	-NHCH <sub>2</sub> -		H

20070929 09:40:00

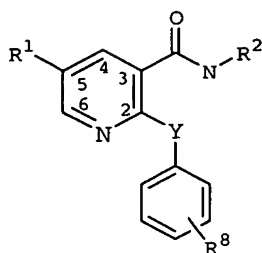


Table 3. cont.



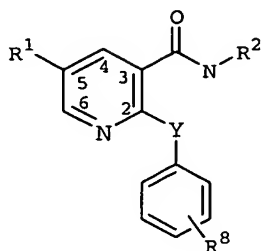
5	#	$R^8$	Y	$R^2$	$R^1$
	255.	4-F	-NHCH <sub>2</sub> -		H
	256.	4-F	-NHCH <sub>2</sub> -		H
	257.	3,4-diF	-NHCH <sub>2</sub> -		H
	258.	H	-NHCH <sub>2</sub> -		H
10	259.	4-F	-NHCH <sub>2</sub> -		H
	260.	4-F	-NHCH <sub>2</sub> -		H
	261.	3,4-diF	-NH(CH <sub>2</sub> ) <sub>2</sub> -		H
	262.	H	-NH(CH <sub>2</sub> ) <sub>2</sub> -		H

Table 3. cont.



5	#	R <sup>8</sup>	Y	R <sup>2</sup>	R <sup>1</sup>
	263.	4-F	-NH(CH <sub>2</sub> ) <sub>2</sub> -		H
	264.	4-F	-NH(CH <sub>2</sub> ) <sub>2</sub> -		H
	265.	3,4-diF	-NHCH <sub>2</sub> -		H
	266.	H	-NHCH <sub>2</sub> -		H
10	267.	4-F	-NHCH <sub>2</sub> -		H
	268.	4-F	-NHCH <sub>2</sub> -		H

Table 3. cont.



5	#	$R^8$	Y	$R^2$	$R^1$
	269.	4-F	-NHCH <sub>2</sub> -		H
	270.	4-F	-NHCH <sub>2</sub> -		H
	271.	4-F	-NHCH <sub>2</sub> -		H
	272.	4-F	-NHCH <sub>2</sub> -		H

Although the pharmacological properties of the compounds of Formulas I-III vary with structural change, in general, activity possessed by compounds of Formulas I-III may be demonstrated *in vivo*. The pharmacological properties of the compounds of this invention may be confirmed by a number of pharmacological *in vitro* assays. The exemplified pharmacological assays which follow have been carried out with the compounds according to the invention and their salts. Compounds of the present invention showed inhibition of KDR kinase at doses less than 50  $\mu\text{m}$ .

#### BIOLOGICAL EVALUATION

##### HUVEC Proliferation Assay

Human Umbilical Vein Endothelial cells are purchased from Clonetics, Inc., as cryopreserved cells harvested from a pool of donors. These cells, at passage 1, are thawed and expanded in EBM-2 complete medium, until passage 2 or 3. The cells are trypsinized, washed in DMEM + 10% FBS + antibiotics, and spun at 1000 rpm for 10 min. Prior to centrifugation of the cells, a small amount is collected for a cell count. After centrifugation, the medium is discarded, and the cells are resuspended in the appropriate volume of DMEM + 10% FBS + antibiotics to achieve a concentration of  $3 \times 10^5$  cells/mL. Another cell count is performed to confirm the cell concentration. The cells are diluted to  $3 \times 10^4$  cells/mL in DMEM + 10% FBS + antibiotics, and 100  $\mu\text{L}$  of cells are added to a 96-well plate. The cells are incubated at 37°C for 22 h.

Prior to the completion of the incubation period, compound dilutions are prepared. Five-point, five-fold serial dilutions are prepared in DMSO, at concentrations 400-fold greater than the final concentrations desired. 2.5  $\mu\text{L}$  of each compound dilution are diluted further in a total

of 1 mL DMEM + 10% FBS + antibiotics (400x dilution).  
Medium containing 0.25% DMSO is also prepared for the 0  $\mu$ M  
compound sample. At the 22-hour timepoint, the medium is  
removed from the cells, and 100  $\mu$ L of each compound dilution  
5 is added. The cells are incubated at 37°C for 2-3 h.

During the compound pre-incubation period, the growth  
factors are diluted to the appropriate concentrations.  
Solutions of DMEM + 10% FBS + antibiotics, containing either  
VEGF or bFGF at the following concentrations: 50, 10, 2,  
10 0.4, 0.08, and 0 ng/mL are prepared. For the compound-  
treated cells, solutions of VEGF at 550 ng/mL or bFGF at 220  
ng/mL for 50 ng/mL or 20 ng/mL final concentrations,  
respectively, are prepared since 10  $\mu$ L of each will be added  
to the cells (110  $\mu$ L final volume). At the appropriate time  
15 after adding the compounds, the growth factors are added.  
VEGF is added to one set of plates, while bFGF is added to  
another set of plates. For the growth factor control  
curves, the media on wells B4-G6 of plates 1 and 2 are  
replaced with media containing VEGF or bFGF at the varying  
20 concentrations (50 - 0 ng/mL). The cells are incubated at  
37°C for an additional 72 h.

At the completion of the 72 h incubation period, the  
medium is removed, and the cells are washed twice with PBS.  
After the second wash with PBS, the plates are tapped gently  
25 to remove excess PBS, and the cells are placed at -70°C for  
at least 30 min. The cells are thawed and analyzed using  
the CyQuant fluorescent dye (Molecular Probes C-7026),  
following the manufacturer's recommendations. The plates  
are read on a Victor/Wallac 1420 workstation at 485 nm/530  
30 nm (excitation/emission). Raw data are collected and  
analyzed using a 4-parameter fit equation in XLFit. IC<sub>50</sub>  
values are then determined.

The compounds of examples 16-17 20-21, 25-27, 29, 34-  
35, 39-42, 45-46, 52, 54-57, 58-65, 212, 215 and 243-245

inhibited VEGF-stimulated HUVEC proliferation at a level below 50 nM.

## Angiogenesis Model

5

To determine the effects of the present compounds on angiogenesis *in vivo*, selective compounds are tested in the rat corneal neovascularization micropocket model or the angiogenesis assay of Passaniti, Lab. Invest., 67, 519-28 (1992).

### Rat Corneal Neovascularization Micropocket Model

**In Life Aspects:** Female Sprague Dawley rats weighing approximately 250 g were randomized into one of five treatment groups. Pretreatment with the vehicle or compound was administered orally, 24 h prior to surgery and continued once a day for seven additional days. On the day of surgery, the rats were temporarily anesthetized in an Isofluorane gas chamber (delivering 2.5 liters/min oxygen + 5% Isofluorane). An othoscope was then placed inside the mouth of the animal to visualize the vocal cords. A tip-blunted wire was advanced in between the vocal cords and used as a guide for the placement of an endotracheal Teflon tube (Small Parts Inc. TFE-standard Wall R-SWTT-18). A volume-controlled ventilator (Harvard Apparatus, Inc. Model 683) was connected to the endotracheal tube to deliver a mixture of oxygen and 3% Isofluorane. Upon achieving deep anesthesia, the whiskers were cut short and the eye areas and eyes gently washed with Betadine soap and rinsed with sterile saline. The corneas were irrigated with one to two drops of Proparacaine HCl ophthalmic topical anesthetic solution (0.5%) (Bausch and Lomb Pharmaceuticals, Tampa FL). The rat was then positioned under the dissecting microscope and the corneal surface brought into focus. A vertical

incision was made on the midline of the cornea using a diamond blade knife. A pocket was created by using fine scissors to separate the connective tissue layers of the stroma, tunneling towards the limbus of the eye. The distance between the apex of the pocket and the limbus was approximately 1.5 mm. After the pocket had been made, the soaked nitrocellulose disk filter (Gelman Sciences, Ann Arbor MI.) was inserted under the lip of the pocket. This surgical procedure was performed on both eyes. rHu-bFGF soaked disks were placed into the right eye, and the rHu-VEGF soaked disks were placed into the left eye. Vehicle soaked disks were placed in both eyes. The disk was pushed into position at the desired distance from the limbal vessels. Ophthalmic antibiotic ointment was applied to the eye to prevent drying and infection. After seven days, the rats were euthanized by CO<sub>2</sub> asphyxiation, and the eyes enucleated. The retinal hemisphere of the eye was windowed to facilitate fixation, and the eye placed into formalin overnight.

**Post Mortem Aspects:** After twenty-four hours in fixative, the corneal region of interest was dissected out from the eye, using fine forceps and a razorblade. The retinal hemisphere was trimmed off and the lens extracted and discarded. The corneal dome was bisected and the superfluous cornea trimmed off. The iris, conjunctiva and associated limbal glands were then carefully teased away. Final cuts were made to generate a square 3x3mm containing the disk, the limbus, and the entire zone of neovascularization.

**Gross Image Recording:** The corneal specimens were digitally photographed using a Sony CatsEye DKC5000 camera (A.G. Heinz, Irvine CA) mounted on a Nikon SMZ-U stereo microscope (A.G. Heinz). The corneas were submerged in distilled water and photographed via trans-illumination at

approximately 5.0 diameters magnification.

**Image analysis:** Numerical endpoints were generated using digital micrographs collected from the whole mount corneas after trimming and were used for image analysis on the Metamorph image analysis system (Universal Imaging Corporation, West Chester PA). Three measurements were taken: Disk placement distance from the limbus, number of vessels intersecting a 2.0mm perpendicular line at the midpoint of the disk placement distance, and percent blood vessel area of the diffusion determined by thresholding.

**General Formulations:**

**0.1% BSA in PBS vehicle:** 0.025 g of BSA was added to 25.0 ml of sterile 1X phosphate buffered saline, gently shaken until fully dissolved, and filtered at 0.2  $\mu$ m. Individual 1.0 ml samples were aliquoted into 25 single use vials, and stored at -20°C until use. For the rHu-bFGF disks, a vial of this 0.1% BSA solution was allowed to thaw at room temperature. Once thawed, 10  $\mu$ l of a 100 mM stock solution of DTT was added to the 1 ml BSA vial to yield a final concentration of 1 mM DTT in 0.1% BSA.

**rHu-VEGF Dilutions:**

Prior to the disk implant surgery, 23.8  $\mu$ l of the 0.1% BSA vehicle above was added to a 10  $\mu$ g rHu-VEGF lyophilized vial yielding a final concentration of 10  $\mu$ M.

**rHu-bFGF: Stock concentration of 180 ng/ $\mu$ l:**

R&D rHu- bFGF: Added 139  $\mu$ l of the appropriate vehicle above to the 25  $\mu$ g vial lyophilized vial. 13.3  $\mu$ l of the [180 ng/ $\mu$ l] stock vial and added 26.6  $\mu$ l of vehicle to yield a final concentration of 3.75  $\mu$ M concentration.

**Nitro-cellulose disk preparation:** The tip of a 20-gauge needle was cut off square and beveled with emery paper to create a punch. This tip was then used to cut out  $\approx$ 0.5mm diameter disks from a nitrocellulose filter paper sheet (Gelman Sciences). Prepared disks were then placed into

2004SEP04 09:40:00



Eppendorf microfuge tubes containing solutions of either 0.1% BSA in PBS vehicle, 10  $\mu$ M rHu-VEGF (R&D Systems, Minneapolis, MN), or 3.75  $\mu$ M rHu-bFGF (R&D Systems, Minneapolis, MN) and allowed to soak for 45-60 min before  
5 use. Each nitrocellulose filter disk absorbs approximately 0.1  $\mu$ l of solution.

In the rat micropocket assay, compounds of the present invention will inhibit angiogenesis at a dose of less than 50 mg/kg/day.

10

#### **Tumor model**

A431 cells (ATCC) are expanded in culture, harvested and injected subcutaneously into 5-8 week old female nude  
15 mice (CD1 nu/nu, Charles River Labs) (n=5-15). Subsequent administration of compound by oral gavage (10 - 200 mpk/dose) begins anywhere from day 0 to day 29 post tumor cell challenge and generally continues either once or twice a day for the duration of the experiment. Progression of  
20 tumor growth is followed by three dimensional caliper measurements and recorded as a function of time. Initial statistical analysis is done by repeated measures analysis of variance (RMANOVA), followed by Scheffe post hoc testing for multiple comparisons. Vehicle alone (Ora-Plus, pH 2.0)  
25 is the negative control. Compounds of the present invention are active at doses less than 150 mpk.

#### **Rat Adjuvant Arthritis Model:**

30 The rat adjuvant arthritis model (Pearson, Proc. Soc. Exp. Biol. 91, 95-101 (1956)) is used to test the anti-arthritic activity of compounds of the Formula I-III, or salts thereof. Adjuvant Arthritis can be treated using two different dosing schedules: either (i) starting time of

immunization with adjuvant (prophylactic dosing); or from day 15 when the arthritic response is already established (therapeutic dosing). Preferably a therapeutic dosing schedule is used.

5

#### **Rat Carrageenan-induced Analgesia Test**

The rat carrageenan analgesia test was performed with materials, reagents and procedures essentially as described by Hargreaves, et al., (Pain, 32, 77 (1988)). Male Sprague-Dawley rats were treated as previously described for the Carrageenan Foot Pad Edema test. Three hours after the injection of the carrageenan, the rats were placed in a special plexiglass container with a transparent floor having a high intensity lamp as a radiant heat source, positionable under the floor. After an initial twenty minute period, thermal stimulation was begun on either the injected foot or on the contralateral uninjected foot. A photoelectric cell turned off the lamp and timer when light was interrupted by paw withdrawal. The time until the rat withdraws its foot was then measured. The withdrawal latency in seconds was determined for the control and drug-treated groups, and percent inhibition of the hyperalgesic foot withdrawal determined.

25

#### **Formulations**

Also embraced within this invention is a class of pharmaceutical compositions comprising the active compounds of Formulas I-III in association with one or more non-toxic, pharmaceutically-acceptable carriers and/or diluents and/or adjuvants (collectively referred to herein as "carrier" materials) and, if desired, other active ingredients. The active compounds of the present invention may be administered by any suitable route, preferably in the form

2025 RELEASE UNDER E.O. 14176

of a pharmaceutical composition adapted to such a route, and in a dose effective for the treatment intended. The compounds and compositions of the present invention may, for example, be administered orally, mucosally, topically, 5 rectally, pulmonarily such as by inhalation spray, or parentally including intravascularly, intravenously, intraperitoneally, subcutaneously, intramuscularly intrasternally and infusion techniques, in dosage unit formulations containing conventional pharmaceutically 10 acceptable carriers, adjuvants, and vehicles.

The pharmaceutically active compounds of this invention can be processed in accordance with conventional methods of pharmacy to produce medicinal agents for administration to patients, including humans and other 15 mammals.

For oral administration, the pharmaceutical composition may be in the form of, for example, a tablet, capsule, suspension or liquid. The pharmaceutical composition is preferably made in the form of a dosage unit 20 containing a particular amount of the active ingredient. Examples of such dosage units are tablets or capsules. For example, these may contain an amount of active ingredient from about 1 to 2000 mg, preferably from about 1 to 500 mg. A suitable daily dose for a human or other mammal may vary 25 widely depending on the condition of the patient and other factors, but, once again, can be determined using routine methods.

The amount of compounds which are administered and the dosage regimen for treating a disease condition with the 30 compounds and/or compositions of this invention depends on a variety of factors, including the age, weight, sex and medical condition of the subject, the type of disease, the severity of the disease, the route and frequency of administration, and the particular compound employed. Thus,

the dosage regimen may vary widely, but can be determined routinely using standard methods. A daily dose of about 0.01 to 500 mg/kg body weight, preferably between about 0.1 and about 50 mg/kg body weight, may be appropriate. The  
5 daily dose can be administered in one to four doses per day.

For therapeutic purposes, the active compounds of this invention are ordinarily combined with one or more adjuvants appropriate to the indicated route of  
10 administration. If administered per os, the compounds may be admixed with lactose, sucrose, starch powder, cellulose esters of alkanolic acids, cellulose alkyl esters, talc, stearic acid, magnesium stearate, magnesium oxide, sodium and calcium salts of phosphoric and sulfuric acids,  
15 gelatin, acacia gum, sodium alginate, polyvinylpyrrolidone, and/or polyvinyl alcohol, and then tableted or encapsulated for convenient administration. Such capsules or tablets may contain a controlled-release formulation as may be provided in a dispersion of active compound in hydroxypropylmethyl  
20 cellulose.

In the case of psoriasis and other skin conditions, it may be preferable to apply a topical preparation of compounds of this invention to the affected area two to four times a day.

25 Formulations suitable for topical administration include liquid or semi-liquid preparations suitable for penetration through the skin (e.g., liniments, lotions, ointments, creams, or pastes) and drops suitable for administration to the eye, ear, or nose. A suitable  
30 topical dose of active ingredient of a compound of the invention is 0.1 mg to 150 mg administered one to four, preferably one or two times daily. For topical administration, the active ingredient may comprise from 0.001% to 10% w/w, e.g., from 1% to 2% by weight of the

formulation, although it may comprise as much as 10% w/w, but preferably not more than 5% w/w, and more preferably from 0.1% to 1% of the formulation.

When formulated in an ointment, the active ingredients may be employed with either paraffinic or a water-miscible ointment base. Alternatively, the active ingredients may be formulated in a cream with an oil-in-water cream base. If desired, the aqueous phase of the cream base may include, for example at least 30% w/w of a polyhydric alcohol such as propylene glycol, butane-1,3-diol, mannitol, sorbitol, glycerol, polyethylene glycol and mixtures thereof. The topical formulation may desirably include a compound which enhances absorption or penetration of the active ingredient through the skin or other affected areas. Examples of such dermal penetration enhancers include DMSO and related analogs.

The compounds of this invention can also be administered by a transdermal device. Preferably transdermal administration will be accomplished using a patch either of the reservoir and porous membrane type or of a solid matrix variety. In either case, the active agent is delivered continuously from the reservoir or microcapsules through a membrane into the active agent permeable adhesive, which is in contact with the skin or mucosa of the recipient. If the active agent is absorbed through the skin, a controlled and predetermined flow of the active agent is administered to the recipient. In the case of microcapsules, the encapsulating agent may also function as the membrane.

The oily phase of the emulsions of this invention may be constituted from known ingredients in a known manner. While the phase may comprise merely an emulsifier, it may comprise a mixture of at least one emulsifier with a fat or an oil or with both a fat and an oil. Preferably, a hydrophilic emulsifier is included together with a

lipophilic emulsifier which acts as a stabilizer. It is also preferred to include both an oil and a fat. Together, the emulsifier(s) with or without stabilizer(s) make-up the so-called emulsifying wax, and the wax together with the oil and fat make up the so-called emulsifying ointment base which forms the oily dispersed phase of the cream formulations. Emulsifiers and emulsion stabilizers suitable for use in the formulation of the present invention include Tween 60, Span 80, cetostearyl alcohol, myristyl alcohol, glyceryl monostearate, sodium lauryl sulfate, glyceryl distearate alone or with a wax, or other materials well known in the art.

The choice of suitable oils or fats for the formulation is based on achieving the desired cosmetic properties, since the solubility of the active compound in most oils likely to be used in pharmaceutical emulsion formulations is very low. Thus, the cream should preferably be a non-greasy, non-staining and washable product with suitable consistency to avoid leakage from tubes or other containers. Straight or branched chain, mono- or dibasic alkyl esters such as di-isoadipate, isocetyl stearate, propylene glycol diester of coconut fatty acids, isopropyl myristate, decyl oleate, isopropyl palmitate, butyl stearate, 2-ethylhexyl palmitate or a blend of branched chain esters may be used. These may be used alone or in combination depending on the properties required. Alternatively, high melting point lipids such as white soft paraffin and/or liquid paraffin or other mineral oils can be used.

Formulations suitable for topical administration to the eye also include eye drops wherein the active ingredients are dissolved or suspended in suitable carrier, especially an aqueous solvent for the active ingredients. The active ingredients are preferably present in such

formulations in a concentration of 0.5 to 20%,  
advantageously 0.5 to 10% and particularly about 1.5% w/w.

Formulations for parenteral administration may be in  
the form of aqueous or non-aqueous isotonic sterile  
5 injection solutions or suspensions. These solutions and  
suspensions may be prepared from sterile powders or granules  
using one or more of the carriers or diluents mentioned for  
use in the formulations for oral administration or by using  
other suitable dispersing or wetting agents and suspending  
10 agents. The compounds may be dissolved in water,  
polyethylene glycol, propylene glycol, ethanol, corn oil,  
cottonseed oil, peanut oil, sesame oil, benzyl alcohol,  
sodium chloride, tragacanth gum, and/or various buffers.  
Other adjuvants and modes of administration are well and  
15 widely known in the pharmaceutical art. The active  
ingredient may also be administered by injection as a  
composition with suitable carriers including saline,  
dextrose, or water, or with cyclodextrin (ie. Captisol),  
cosolvent solubilization (ie. propylene glycol) or micellar  
20 solubilization (ie. Tween 80).

The sterile injectable preparation may also be a  
sterile injectable solution or suspension in a non-toxic  
parenterally acceptable diluent or solvent, for example as a  
solution in 1,3-butanediol. Among the acceptable vehicles  
25 and solvents that may be employed are water, Ringer's  
solution, and isotonic sodium chloride solution. In  
addition, sterile, fixed oils are conventionally employed as  
a solvent or suspending medium. For this purpose any bland  
fixed oil may be employed, including synthetic mono- or  
30 diglycerides. In addition, fatty acids such as oleic acid  
find use in the preparation of injectables.

For pulmonary administration, the pharmaceutical  
composition may be administered in the form of an aerosol or  
with an inhaler including dry powder aerosol.

Suppositories for rectal administration of the drug can be prepared by mixing the drug with a suitable non-irritating excipient such as cocoa butter and polyethylene glycols that are solid at ordinary temperatures but liquid  
5 at the rectal temperature and will therefore melt in the rectum and release the drug.

The pharmaceutical compositions may be subjected to conventional pharmaceutical operations such as sterilization and/or may contain conventional adjuvants,  
10 such as preservatives, stabilizers, wetting agents, emulsifiers, buffers etc. Tablets and pills can additionally be prepared with enteric coatings. Such compositions may also comprise adjuvants, such as wetting, sweetening, flavoring, and perfuming agents.

15 The foregoing is merely illustrative of the invention and is not intended to limit the invention to the disclosed compounds. Variations and changes which are obvious to one skilled in the art are intended to be within the scope and nature of the invention which are defined in the appended  
20 claims.

From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this invention, and without departing from the spirit and scope thereof, can make various changes and modifications of the  
25 invention to adapt it to various usages and conditions.

All mentioned references, patents, applications and publications, are hereby incorporated by reference in their entirety, as if here written.